

INVESTIGATION OF WELDING THERMAL STRAINS IN  
HIGH STRENGTH QUENCHED AND TEMPERED STEEL

Mark D. Lipsey

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by

MARK D. LIPSEY

Submitted to the Department of Ocean Engineering on May 12, 1978 in partial fulfillment of the requirements for the Degree of Ocean Engineer and to the Department of Materials Science and Engineering on May 12, 1978 in partial fulfillment of the requirements of the Degree of Master of Science in Materials Engineering.

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Previous studies of transient thermal strains during welding of high strength quenched and tempered steels are discussed. Data on the transient strain and temperature response during welding experiments on HY-130 and low carbon steel are presented. The experiments consisted of unrestrained, multipass, butt welds in one inch thick plates.

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Recommendations are made which include a comparison of results with a two-dimensional computer analysis and a metallurgical characterization of both the weld metal and the base metal near the weld.

Thesis Supervisor: Koichi Masubuchi

Title: Professor of Ocean Engineering and Materials Science

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IN HIGH STRENGTH QUENCHED AND TEMPERED STEEL

by

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B.S., Metallurgy and Materials Science  
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(1970)

SUBMITTED IN PARTIAL FULFILLMENT  
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at the  
MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
June, 1978

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# REPORT OF THE COMMISSION ON THE KILLING OF MARTIN LUTHER KING, JR.

U.S. GOVERNMENT PRINTING OFFICE

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The Commission's mandate was to investigate the  
circumstances surrounding the assassination and to  
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The Commission's report, "Report of the Commission on the Killing of Martin Luther King, Jr.," was released on April 4, 1969. It is a comprehensive document that details the Commission's findings and recommendations. The report is organized into several sections, including a summary of the Commission's work, a detailed account of the investigation, and a list of recommendations. The Commission's findings are based on a thorough review of all available evidence, including testimony from witnesses, a review of the FBI's investigation, and a study of the social and political climate in the United States at the time of the assassination. The Commission's recommendations are designed to address the issues that led to the assassination and to ensure that such a tragedy does not happen again.

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## CHAPTER I

### INTRODUCTION

#### A. Background

Welding is the most widely used form of joining in the fabrication of marine structures. It is used almost exclusively in the fabrication of naval vessels for welding offers many advantages over other forms of joining. These advantages include a reduction in structural weight, an increase in structural strength, and ease of attaining air and water tightness. However, welding does suffer from a few disadvantages which derive from the local heating which occurs during the welding process. Complex thermal stresses which occur during welding may cause cracking and mismatching. High tensile residual stresses near the weld may promote fracture and fatigue crack propagation. Distortion and compressive residual stress may reduce the buckling strength of structural members.

For many years the development of high strength steels for use in submarines and deep diving submersibles has been pursued in order to lower structural weight, provide for an increase in depth, and to improve the safety characteristics of submersibles. The direction this development has taken is toward the use of quenched and tempered steels. By use of proper production procedures,





it is possible to achieve high strength levels as well as superior fracture toughness behavior in quenched and tempered steels. These two characteristics make the development of quenched and tempered steels highly desirable.

Since the mechanical properties of quenched and tempered steels are mainly derived from the heat treatment applied during production, it follows that the heat input which occurs during welding will have a large effect on the properties of the plate near the weld. The structure of the quenched and tempered steel will give rise to highly complex thermal strains near the weld. The exact nature of these strains is not well understood, but the ability to analytically predict the mechanical behavior of the weldment in these complex steels will avoid the huge costs of money, time, and manpower which would be required to empirically generate the data necessary to predict and avoid problems in all stages of fabrication. The key to analytically predicting and avoiding problems during the later stages of fabrication is to develop the ability to predict residual stresses and distortion resulting from welding. The most reliable method of achieving this aim is to accurately predict the thermal strains which occur in the metal near the weld line



during the entire welding process.

#### B. Previous Work in Welding Analysis

The passage of a welding arc induces the formation of complex stresses and strains in the base metal near the weld line. This phenomenon is primarily due to the nature of the heat source in that a welding arc causes not only local heating but this local heating source is constantly moving. Therefore, the temperature distribution in the metal is non-uniform and it is this non-uniformity of temperature distribution which causes thermal strains to develop and change during the welding process. At the conclusion of welding, residual strains and stresses will remain in the metal.

The formation of thermal strains and stresses near the weld line in a low carbon steel, which is due to the passage of the welding arc, is best described by Masubuchi [10] and is repeated here.

"Figure 1 shows schematically how residual stresses are formed in a weld. Figure 1a shows a bead-on-plate weld in which a weld bead is being laid at a speed  $v$ .  $O$ - $xy$  is the coordinate axis; the origin,  $O$ , is on the surface underneath the welding arc, and the  $x$  direction lies in the direction of welding.





Figure 1b shows temperature distribution along several cross sections. Along Section A-A, which is ahead of the welding arc, the temperature change due to welding,  $\Delta T$ , is almost zero (Figure 1b-1). Along Section B-B, which crosses the welding arc, the temperature distribution is very steep (Figure 1b-2). Along Section C-C, which is some distance behind the welding arc, the distribution of temperature change is as shown in Figure 1b-3. Along Section D-D, which is very far from the welding arc, the temperature change due to welding again diminishes (Figure 1b-4).

Figure 1c shows the distribution of stresses along these sections in the x direction,  $\sigma_x$ . Stress in the y direction,  $\sigma_y$ , and shearing stress,  $\tau_{xy}$ , also exist in a two-dimensional stress field.

Along Section A-A, thermal stresses due to welding are almost zero (Figure 1c-1). The stress distribution along Section B-B is shown in Figure 1c-2. Stresses in areas underneath the welding arc are close to zero, because molten metal does not support loads. Stresses in areas somewhat away from the arc are compressive, because the expansion of these areas is restrained by surrounding areas that are heated to lower temperatures. Since the temperatures of these areas are quite high and the yield strength





of the material is low, stresses in these areas are as high as the yield strength of the material at corresponding temperatures. The amount of compressive stress increases with increasing distance from the weld or with decreasing temperature. However, stresses in areas away from the weld are tensile and balance with compressive stresses in areas near the weld. In other words,

$$\int \sigma_x \cdot dy = 0$$

across Section B-B. Thus, the stress distribution along Section B-B is as shown in Figure 1c-2.

Stresses are distributed along Section C-C as shown in Figure 1c-3. Since the weld-metal and base-metal regions near the weld have cooled, they try to shrink causing tensile stresses in areas close to the weld. As the distance from the weld increases, the stresses first change to compressive and then become tensile.

Figure 1c-4 shows the stress distribution along Section D-D. High tensile stresses are produced in areas near the weld, while compressive stresses are produced in areas away from the weld. The distribution of residual stresses that remain after welding is completed is shown in the figure.



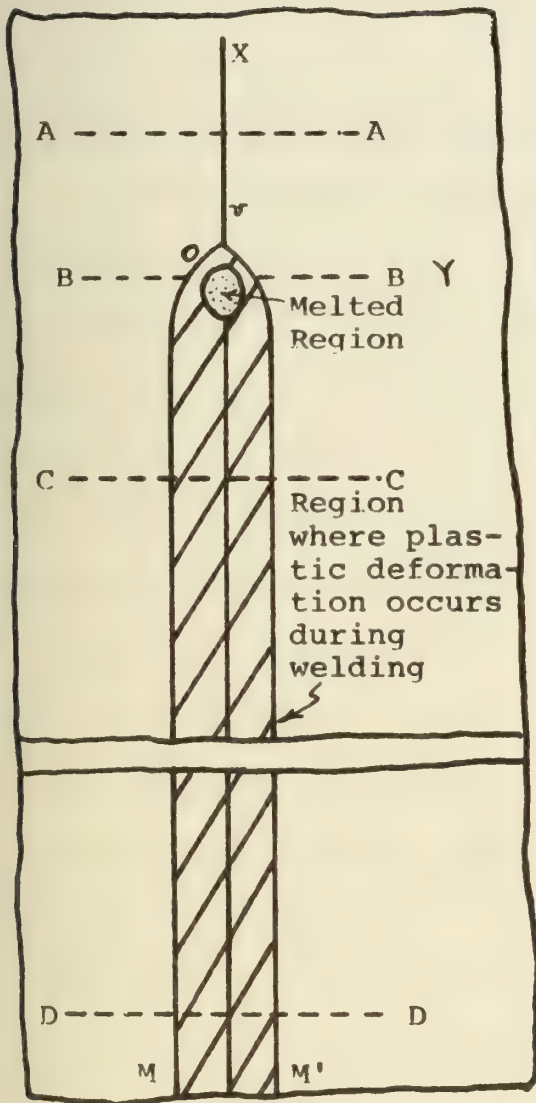
The cross-hatched area, MM', Figure 1a shows the region where plastic deformation occurs during the welding thermal cycle. The cross-hatched area near the origin O indicates the region where the metal is melted. The region outside the cross-hatched area remains elastic during the entire welding thermal cycle."

In the past twenty years, a number of research programs have been directed toward the development of analytical methods of analyzing the formation of these transient thermal strains and the resultant residual stresses and strains in weldments. In 1961, Tall [15] developed a simple computer program in the first significant attempt to use a computer in the analysis of thermal stresses during welding. In his study, temperature distribution was treated as a two-dimensional heat conduction problem but longitudinal stress, in the direction of the weld line, was assumed to be a function of the transverse distance only. Transverse stress and shear stress were assumed to be zero. This type of analysis was designated one-dimensional.

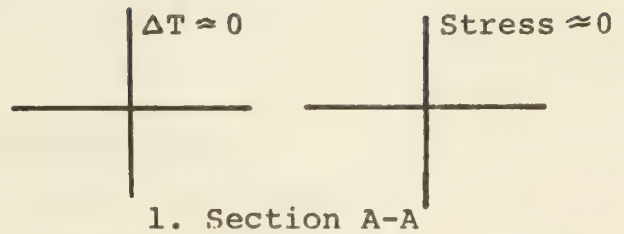
In 1968, Masubuchi, et.al. [11] further developed the above technique to handle thermal stresses in bead-on-plate welding. At MIT in 1970, Masubuchi [2] again improved the one-dimensional program. Later, Bryan [3] modified the



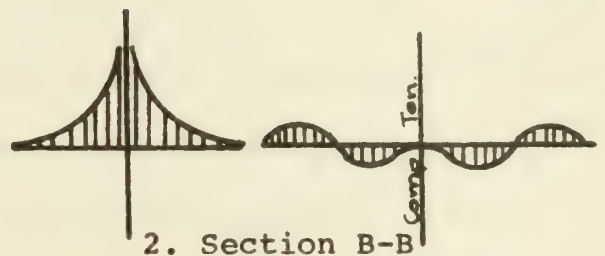




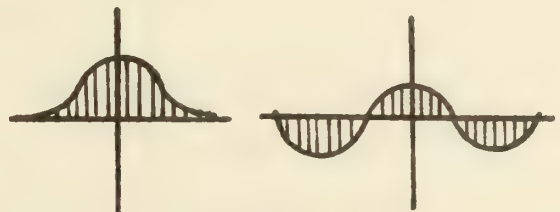
a. Weld



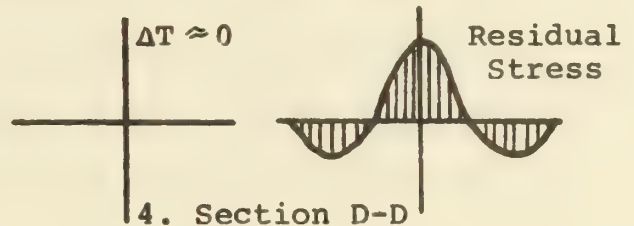
1. Section A-A



2. Section B-B



3. Section C-C



4. Section D-D

b. Temperature Change

c. Stress  $\sigma_x$

Figure 1 - Schematic Representation of Changes in Temperature and Stress During Welding



program so that different materials could be analyzed. Provisions for multipass welding and heat losses from the surface were then incorporated into the program.

### C. Previous Work on High Strength Steels

At MIT, study of thermal stresses resulting from welding of high strength steels has been done in two programs. Most recently, Hwang [6] studied transient thermal strains during welding and residual stresses in high strength steels. This work complemented that reported by Klein [7,8] on transient thermal strains resulting from welding high strength marine steels.

Klein's study [7] of transient thermal strains concentrated on the quenched and tempered marine steels, HY-80 and HY-130. HY-80 specimens were 1/4 inch thick and 3/4 inch thick and were welded bead-on-plate. The HY-130 specimens were 3/4 inch thick and were multipass butt welded. Strain changes were measured on the specimen surface by electric resistance strain gages and temperature on the surface was measured by adhesive bonded thermocouples. The analytical predictions for HY-80 steel did not agree closely with experimental results. The results of multipass welding of HY-130 showed sudden strain changes which occurred following the passage of the welding arc.





It has been speculated that these sudden strain changes may have been due to phase transformations occurring during cooling of the base metal. Another result was that the strains observed near the weld line decreased as the strength level of the base metal increased.

D. Aim and Purpose of Present Study

Most experimental work to date concerning transient thermal strains and stresses has been concentrated on single pass welding of thin plates. Where multipass welding has been studied, specimen plate thicknesses have not exceeded 3/4 inch. Because of this, it has not been adequately determined whether the computer programs developed to analytically predict thermal stresses and strains during welding are accurate for thicker sections.

The quenched and tempered steel to be used in future U.S. Navy submarines and deep-diving submersibles is HY-130. In order to achieve safe and efficient fabrication procedures for this steel, it is necessary to understand the formation of transient thermal strains during welding in order to be able to predict the residual stresses present after welding. Experimental data on transient thermal strains in thick plates of HY-130 are not extensive and further experiments to generate more data are needed to



increase the existing store of knowledge.

Therefore, the primary purpose of this investigation is to generate experimental data on transient thermal strains during welding of thick sections of HY-130 and low carbon steel. Experiments will consist of unrestrained butt welding by the multipass gas-metal-arc process.

Objectives of the experimental program include:

- (1) to verify previous experimental results on HY-130.
- (2) to determine the applicability of the MIT one-dimensional computer program to multipass welding of thick sections.
- (3) to provide useful information for the modification of the present program as well as for the development of more practical computer programs.





## CHAPTER II

### MATERIAL CHARACTERISTICS

The material chosen for this study is a high strength quenched and tempered steel which exhibits a minimum yield stress of 130 ksi. This steel has been developed by the U.S. Navy for use as hull plating and structural members in deep diving submersibles, and is designated HY-130. In addition to the extremely high yield stress, this steel exhibits very good energy absorption characteristics at low temperatures. The chemical composition of HY-130 quenched and tempered steel is presented in Table I. The mechanical properties of HY-130 in the "as received" condition are presented in Table II.

One test specimen was a low carbon steel with a designation 1020. This steel was chosen in order to provide further data on another material for use in validating and improving the MIT one-dimensional computer program. The nominal chemical composition of this steel and its mechanical properties are listed in Table III and Table IV respectively.

In order to analytically study the heat flow and thermal strains which occur during the welding process, it is necessary to know the physical and mechanical properties of the metal as a function of temperature, from room



TABLE I  
COMPOSITION OF HY-130

<u>Element</u>	<u>Weight Percent</u>
Ni	4.75 - 5.25
Cr	0.40 - 0.70
Mn	0.60 - 0.90
Si	0.20 - 0.35
Mo	0.30 - 0.65
V	0.05 - 0.10
C	0.08 - 0.12
P	0.010 maximum
S	0.015 maximum
Ti	0.02 maximum
Cu	0.25 maximum
Fe	Remainder

TABLE II  
MECHANICAL PROPERTIES OF HY-130

Yield Stress	145 ksi
Tensile Stress	147 ksi
Elongation in 2 inches	20%
Reduction of Area	69%
V-Notch Requirements	60 ft-lbs at 70°F and 0°F





TABLE III  
COMPOSITION OF 1020 STEEL

<u>Element</u>	<u>Weight Percent</u>
C	.18 - .23
Mn	.30 - .60
P	.04 maximum
S	.05 maximum
Fe	Remainder

TABLE IV  
MECHANICAL PROPERTIES OF 1020

Yield Stress	48 ksi
Tensile Stress	65 ksi
Elongation in 2 inches	36%
Reduction of Area	59%



temperature through melting temperatures. For most metals this information is not readily available and for HY-130 no systematic study has been made to determine these physical and mechanical properties at elevated temperatures. However, in his study of fracture of welds of HY-130, Schrodtt [13] developed curves for the physical and mechanical properties of HY-130 as functions of temperature which he derived from data published in References [1,5,9, 12, and 16]. At the present time, these curves are the most valid approximations for the properties at elevated temperatures which are available. The mechanical and physical properties of HY-130 as functions of temperature are presented in Figures 2-7. These physical and mechanical properties for 1020 steel can be found in the literature [4] and are presented as functions of temperature in Figures 8-13.



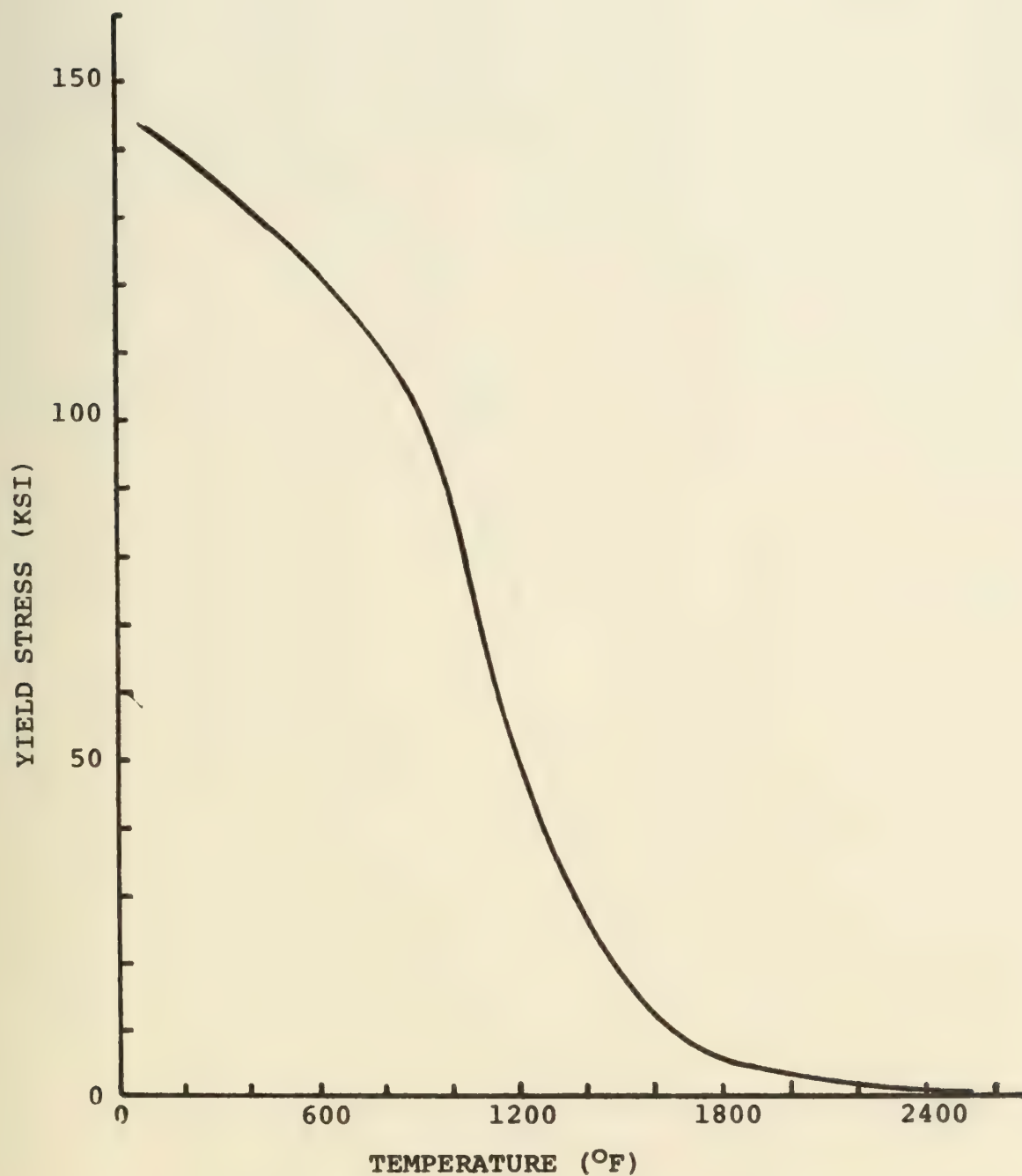


Figure 2 - Estimated Effect of Temperature on 0.2% Offset Yield Stress for HY-130





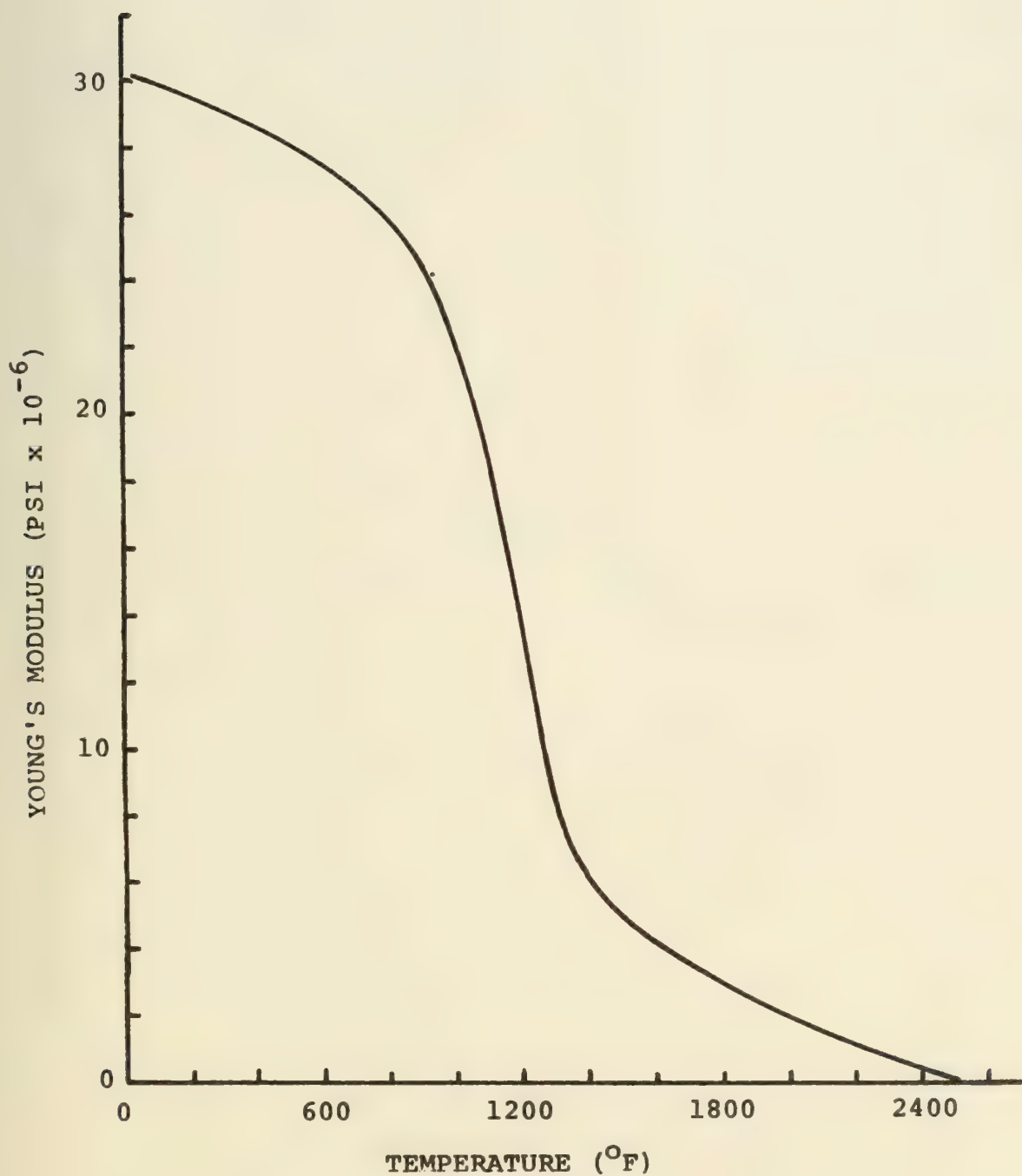


Figure 3 - Estimated Effect of Temperature on Young's Modulus for HY-130



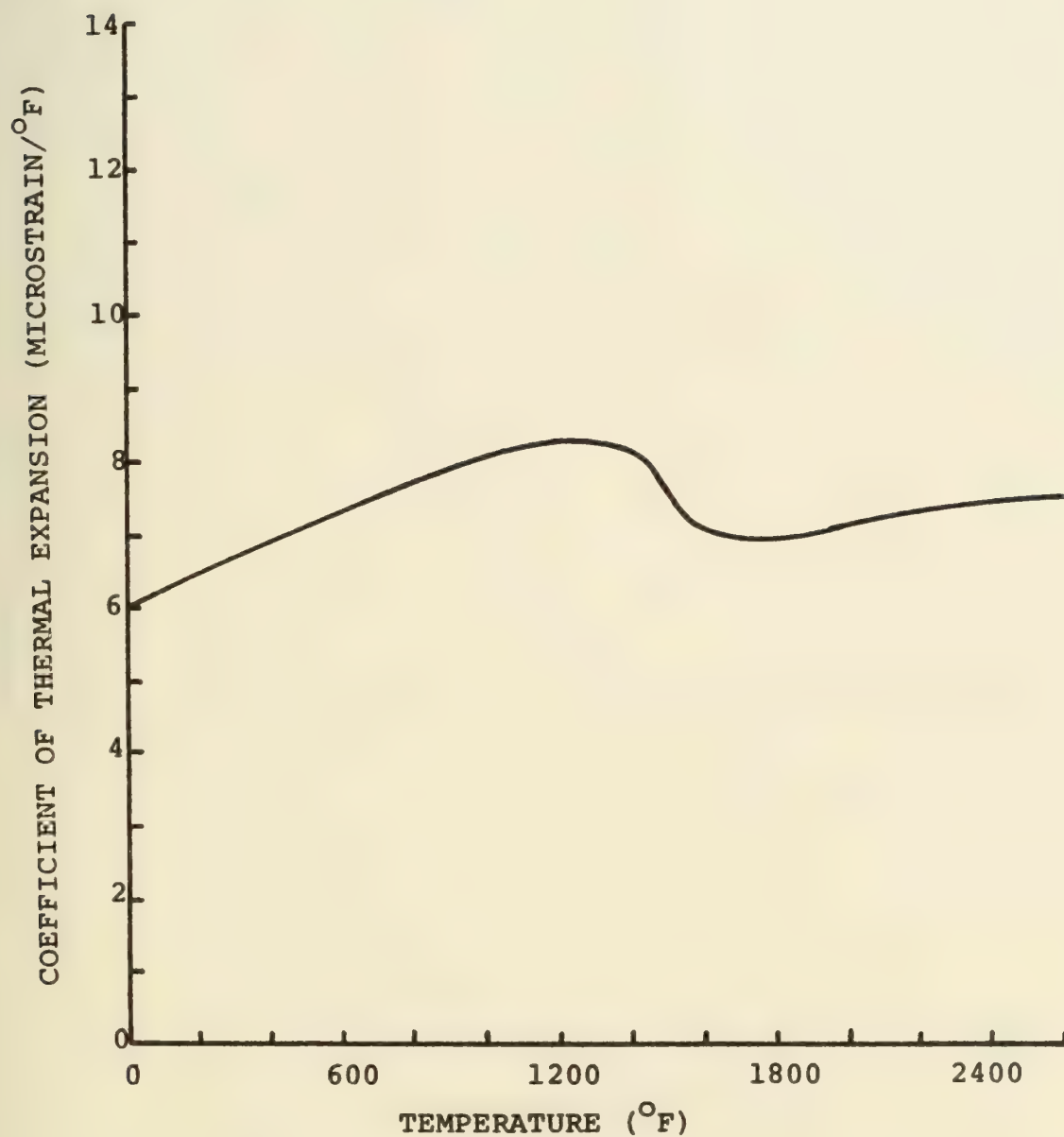


Figure 4 - Estimated Effect of Temperature on the Coefficient of Thermal Expansion for HY-130





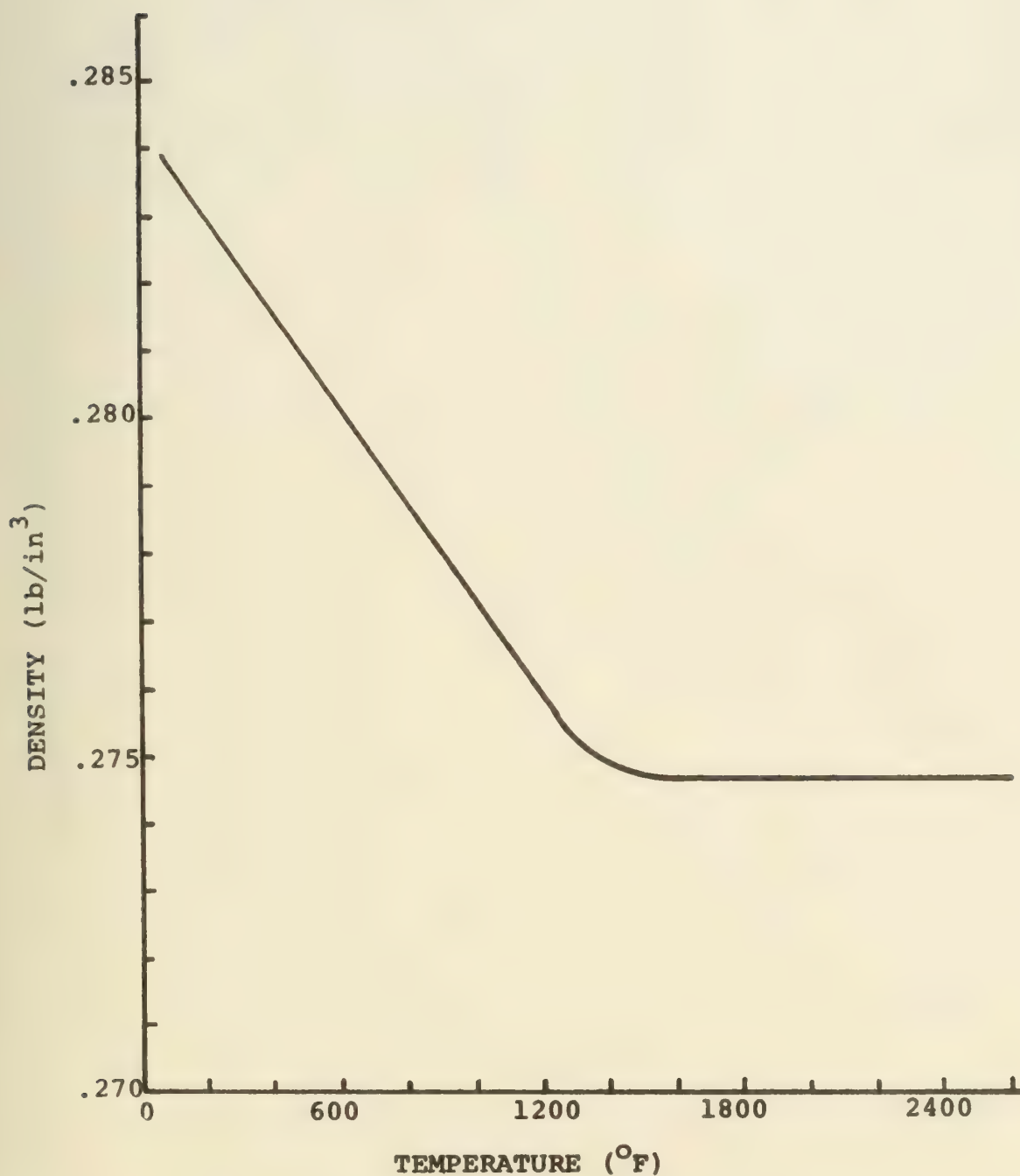


Figure 5 - Estimated Effect of Temperature  
on Density of HY-130



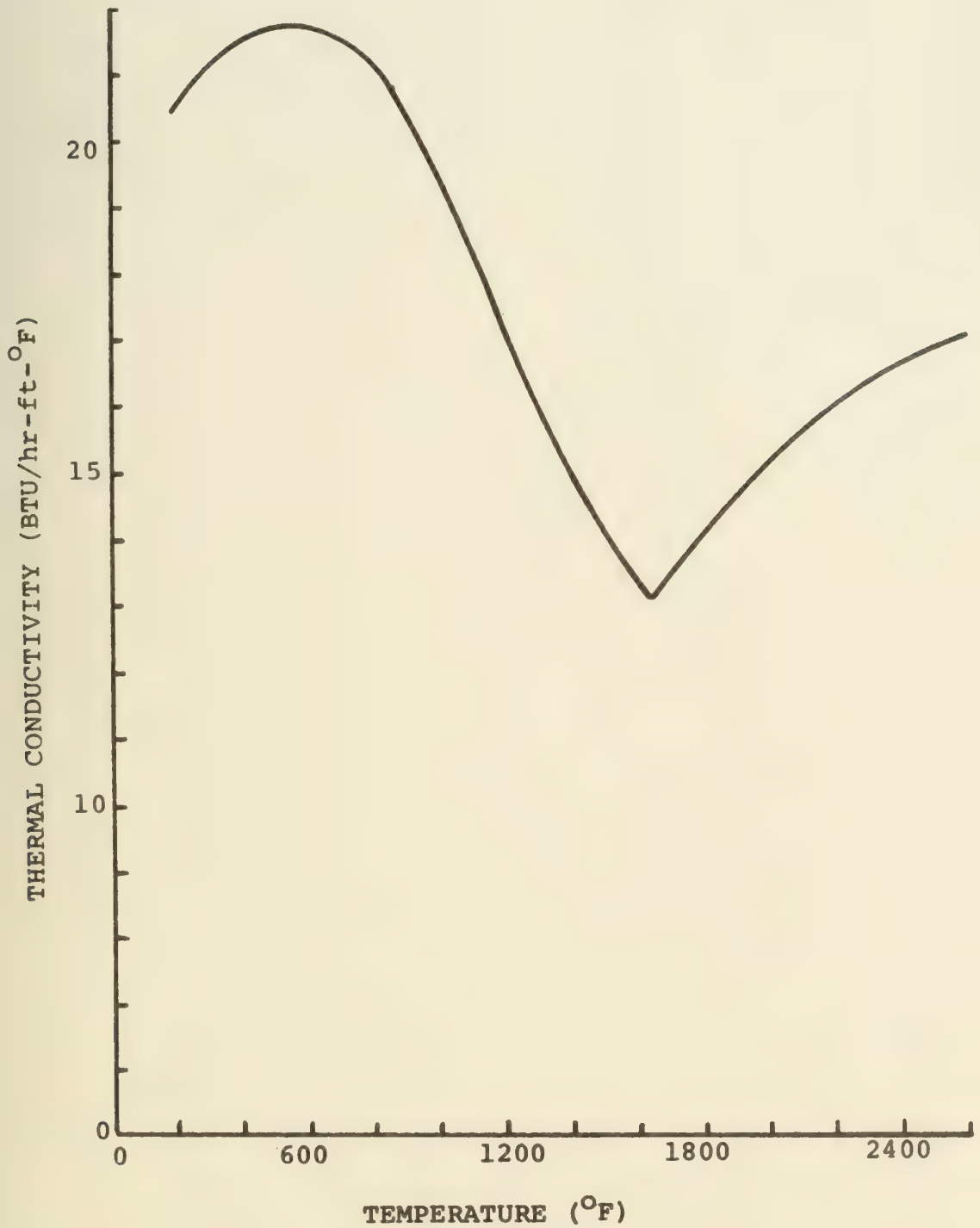


Figure 6 - Estimated Effect of Temperature  
on the Thermal Conductivity of HY-130



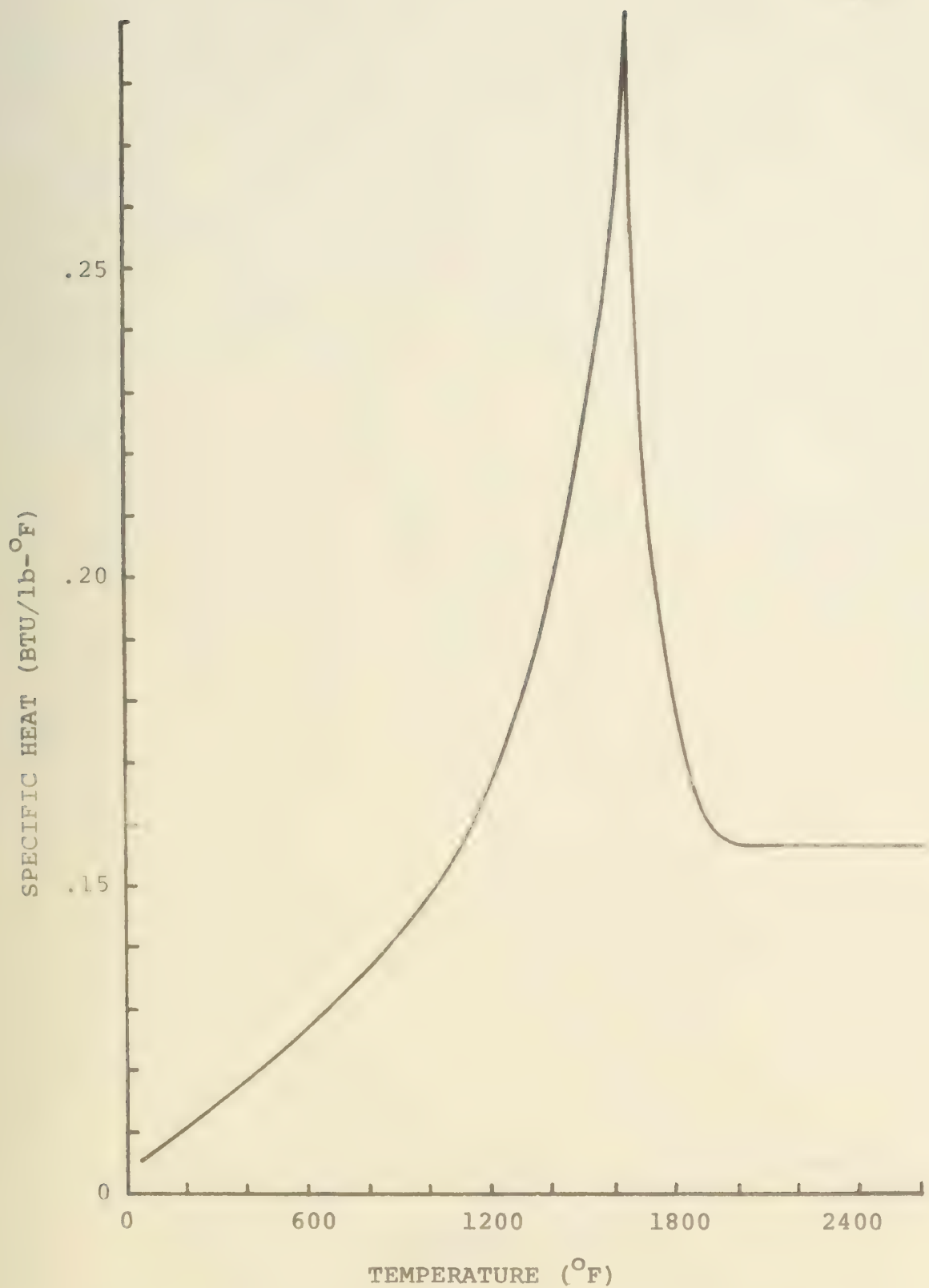


Figure 7 - Estimated Effect of Temperature  
on Specific Heat of HY-130





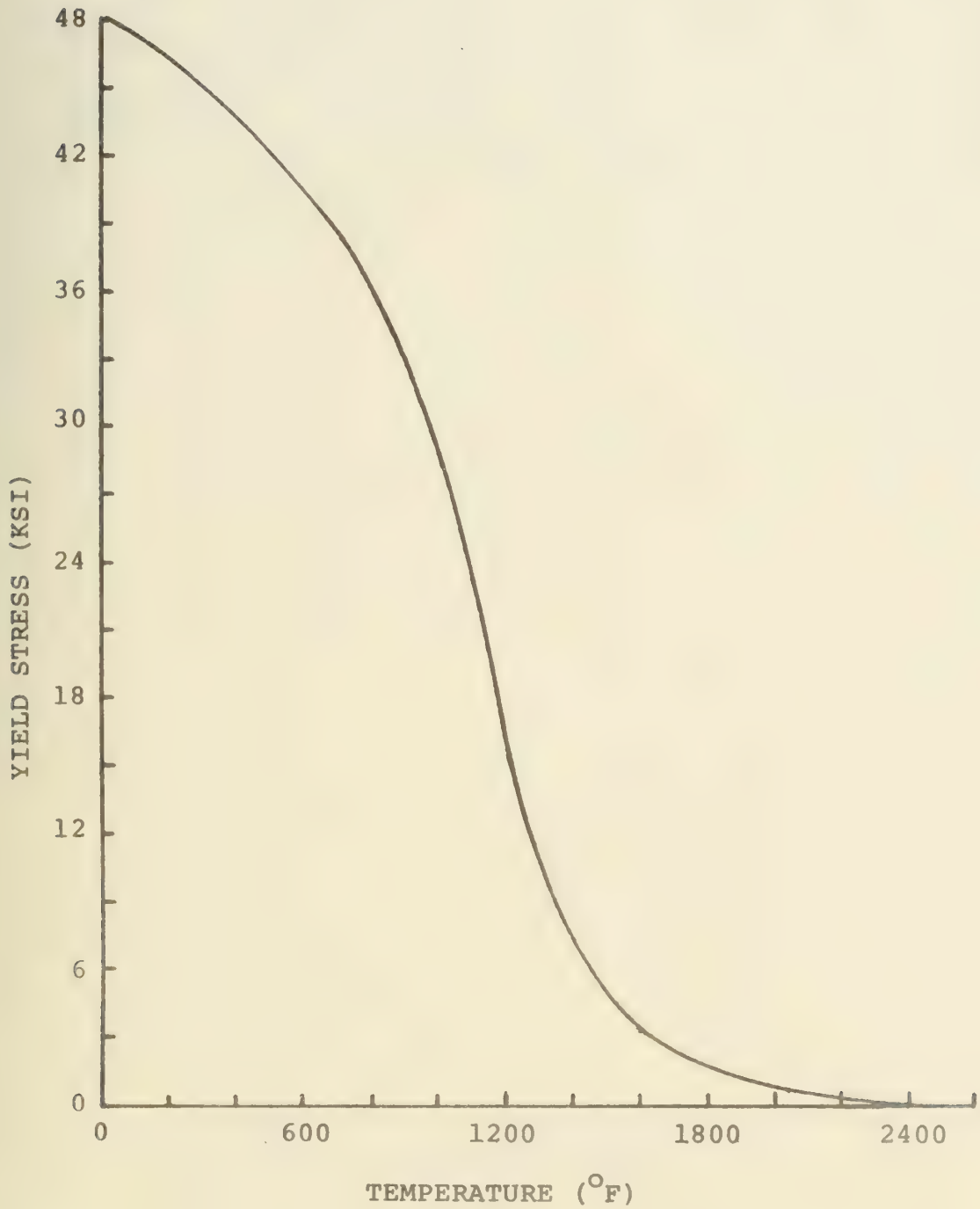


Figure 8 - Estimated Effect of Temperature on 0.2% Offset Yield Stress for 1020 Steel



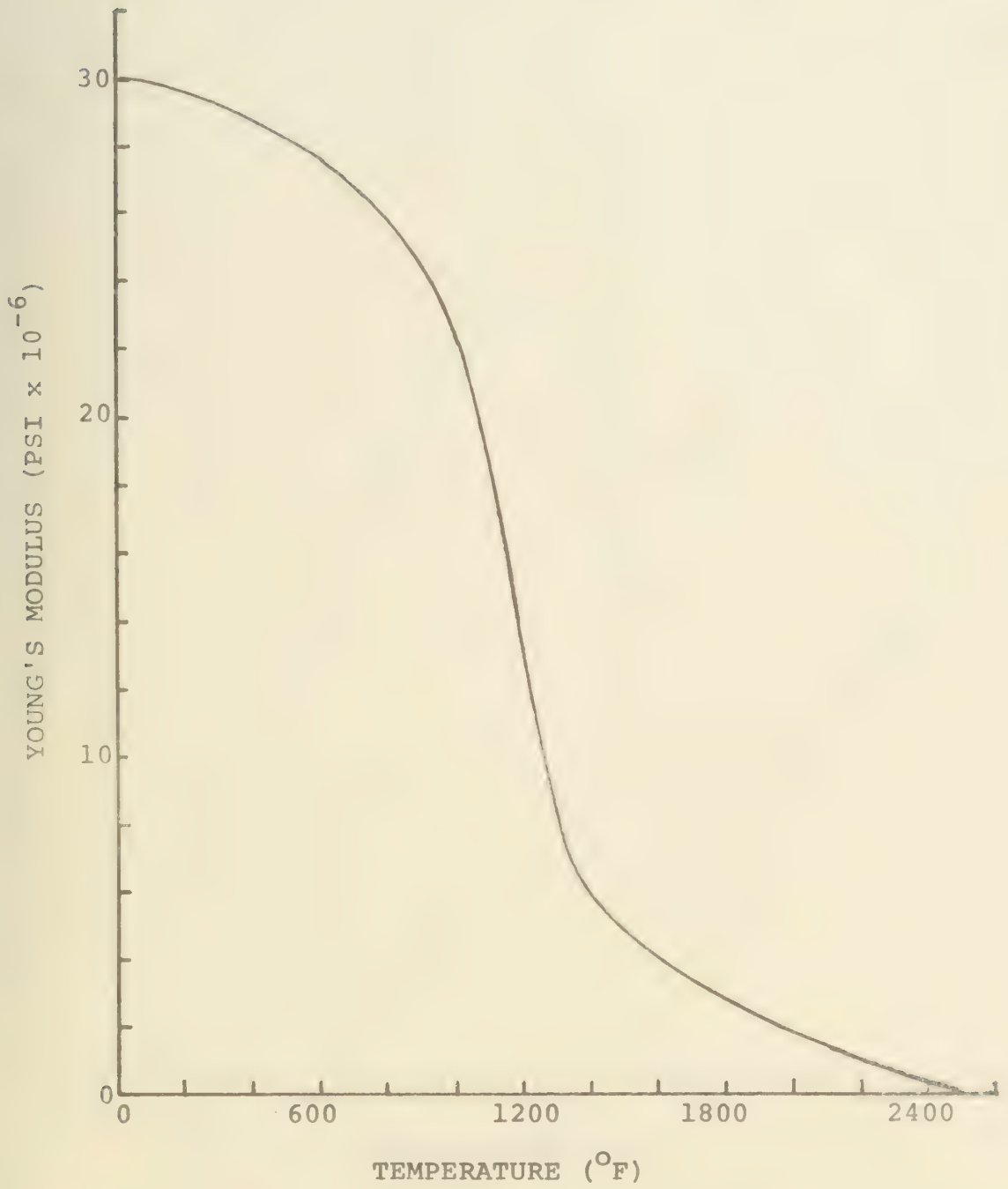


Figure 9 - Estimated Effect of Temperature on Young's Modulus for 1020 Steel





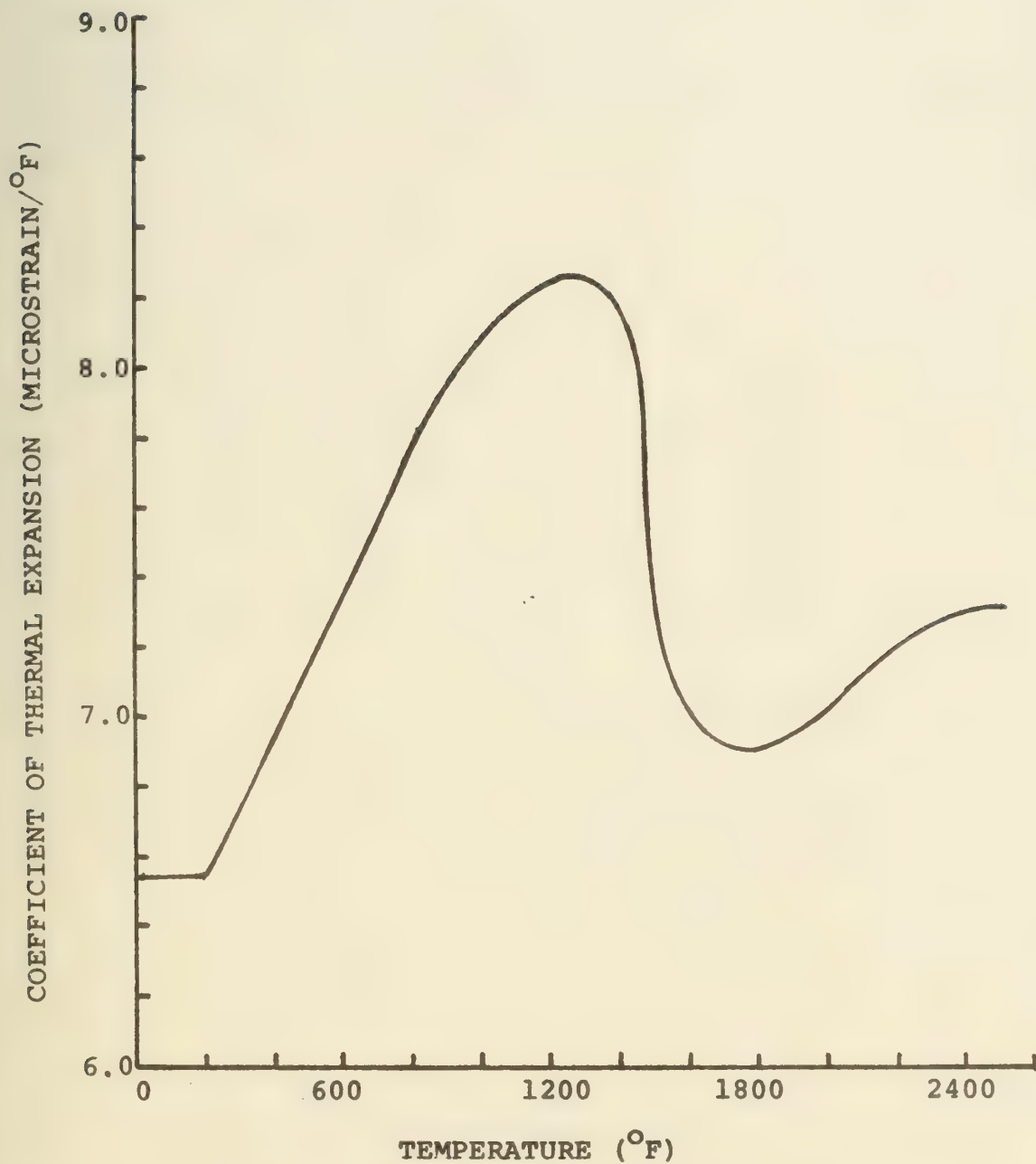


Figure 10 - Estimated Effect of Temperature on the Coefficient of Thermal Expansion for 1020 Steel



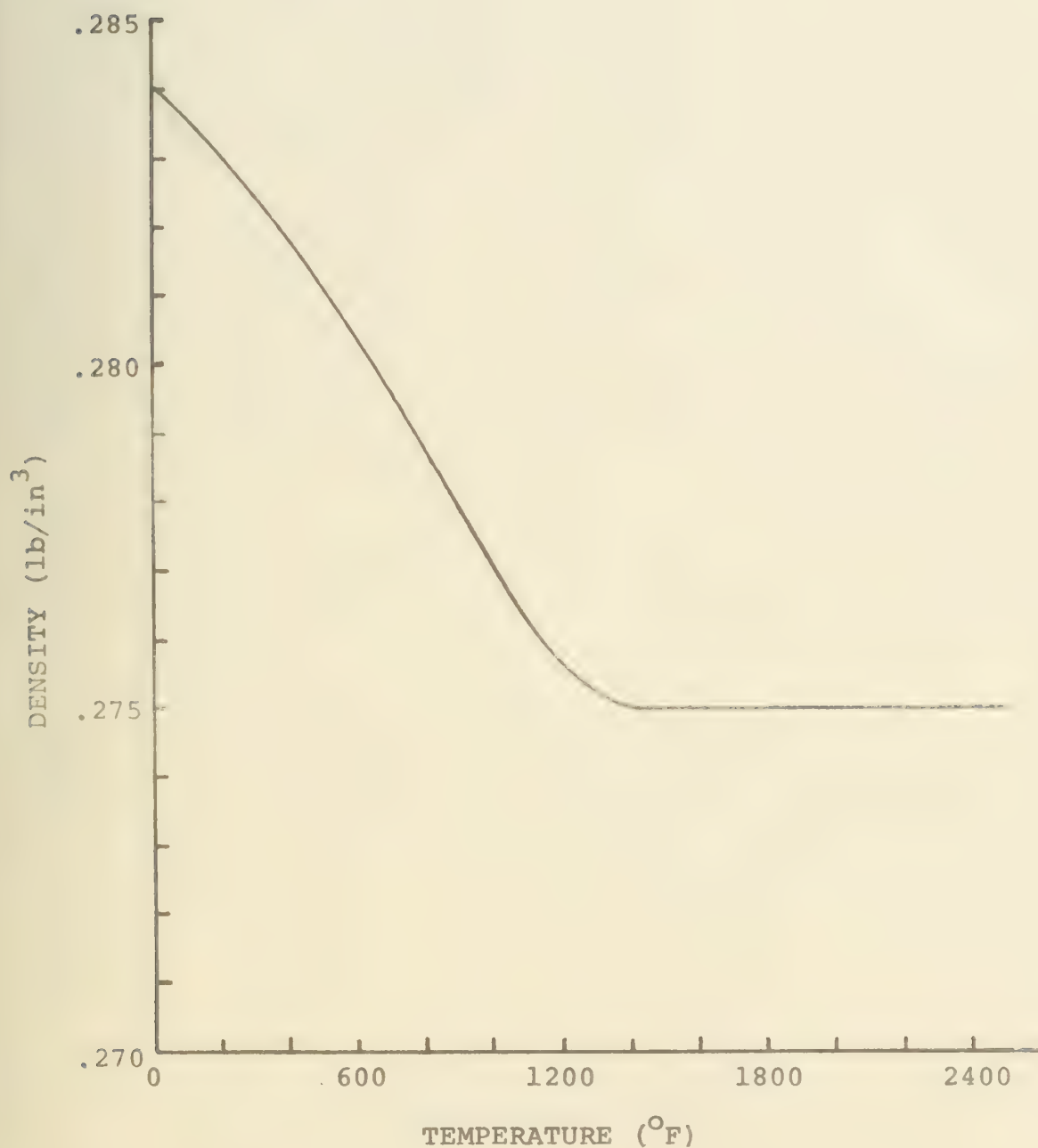


Figure 11 - Estimated Effect of Temperature  
on Density of 1020 Steel



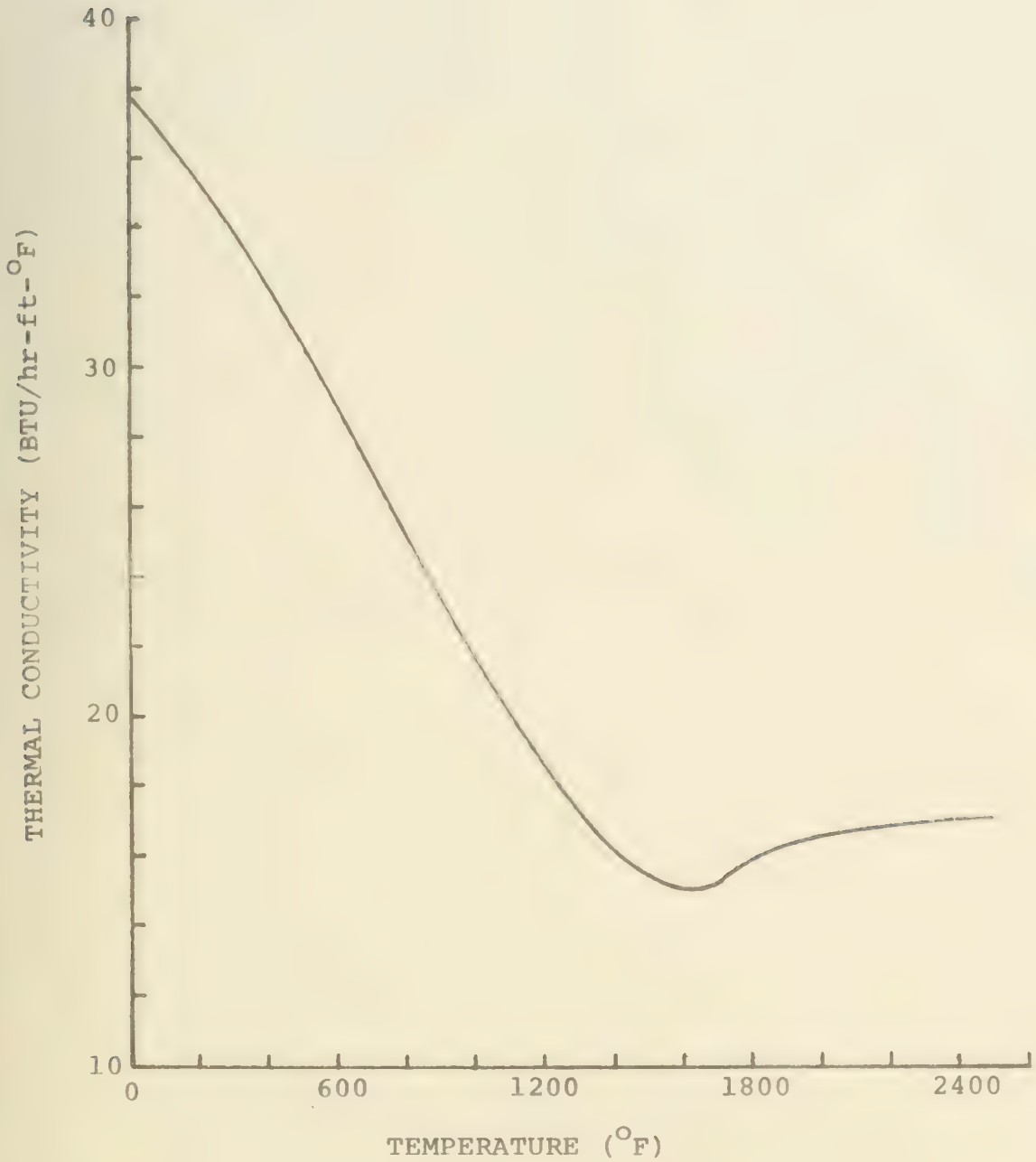


Figure 12 - Estimated Effect of Temperature on the Thermal Conductivity of 1020 Steel





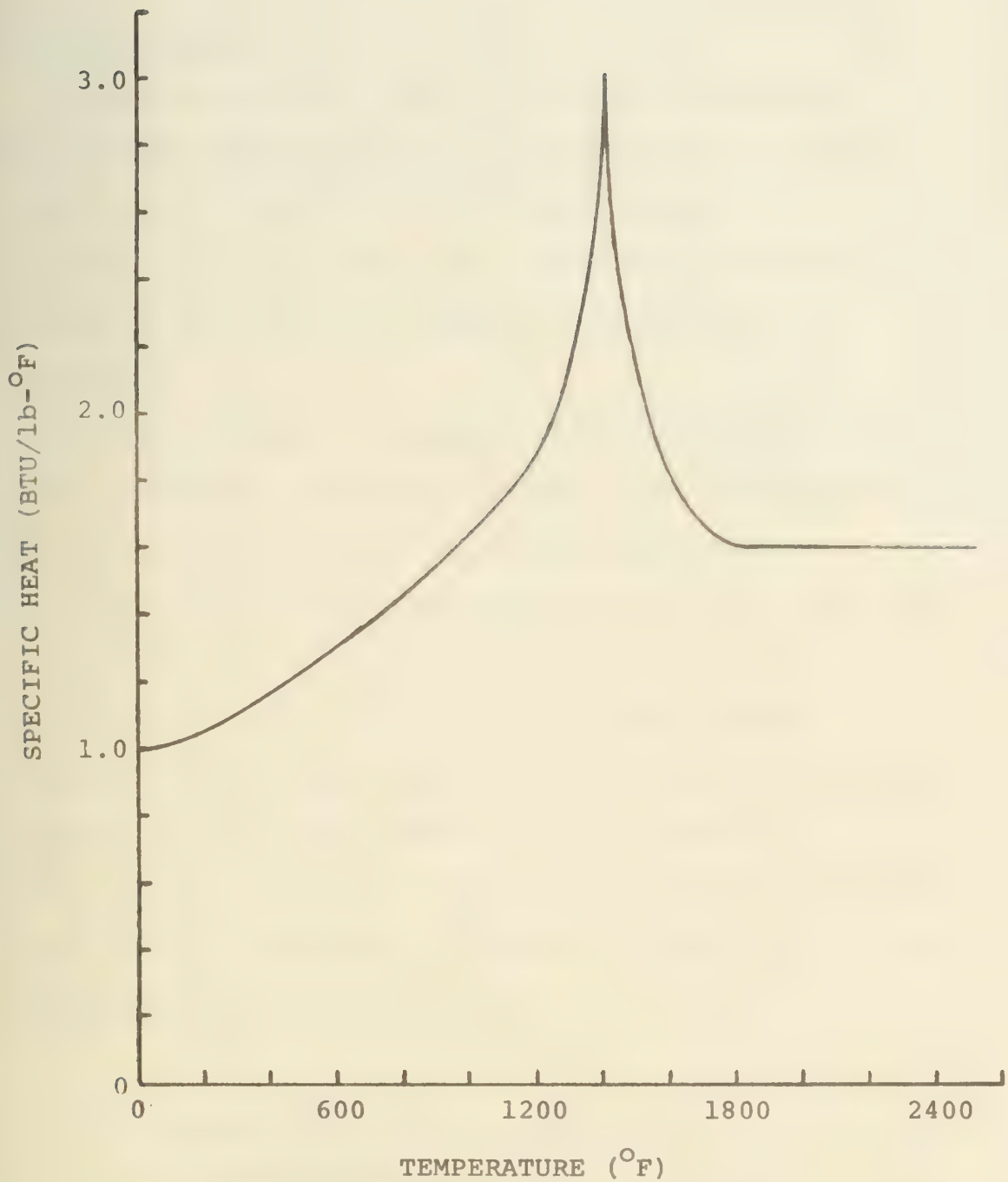


Figure 13 - Estimated Effect of Temperature  
on Specific Heat of 1020 Steel



## CHAPTER III

### PROCEDURES

#### A. Scope of Research

A series of three experiments was conducted to measure temperature changes and thermal strains which occur in thick plate during multipass welding of unrestrained butt joints. Metal movement, as measured by transverse shrinkage, was measured during one of the experiments.

The two primary experiments were conducted with HY-130 steel, a quenched and tempered steel under development by the U.S. Navy for use in deep diving submersibles. U.S. Navy specifications for the fabrication of this steel by the Gas-Metal-Arc method were followed as closely as possible. The third experiment was conducted with a low carbon steel (by using the Gas-Metal-Arc method of welding). The data obtained experimentally were compared to analytical predictions of temperature and strain produced by the MIT one-dimensional computer program for the analysis of thermal strains during welding.

#### B. Measurement of Strain

Strain measurements were made on the surface of the metal plate by use of adhesive bonded, electric resistance



strain gages. This method of strain measurement on the test plate is used extensively and is a convenient and accurate method of measurement. When measuring strain with resistance strain gages, the total resistance change measured,  $\Delta R$ , consists of resistance changes taking place in the test plate due to mechanical strains and thermal strains as well as resistance changes due to thermal strain and thermo-electric changes in the strain gage itself. In the case of welding thermal strains, the total resistance change can therefore be expressed in the following way:

$$\Delta R = \Delta R(e) + \Delta R(p) + \Delta R(T) + \Delta R(g)$$

where

$\Delta R(e)$  = resistance change due to elastic strain  
in the test plate.

$\Delta R(p)$  = resistance change due to plastic strain  
in the test plate.

$\Delta R(T)$  = resistance change due to temperature  
induced thermal strain in the gage.

$\Delta R(g)$  = resistance change due to thermo-  
electric effects in the gage.





In studying welding thermal strains, the measurements of interest are  $\Delta R(e)$  and  $\Delta R(p)$ . These can be separated out from  $\Delta R$  if  $[\Delta R(T) + \Delta R(g)]$  can be determined throughout the temperature range. This correction has been made by the gage manufacturer and is supplied with the gages in the form of a curve of apparent strain versus temperature. Therefore,

$$E\Delta R(e) + E\Delta R(p) = E\Delta R - A.S.$$

where A.S. = apparent strain.

### C. Apparatus

#### 1. Specimen Preparation

All experiments consisted of the unrestrained butt welding of one inch thick plates. Each plate measured approximately 12" x 24" and after welding created a plate with dimensions 24" x 24". In accordance with U.S. Navy specifications, the weld joint configuration chosen was a double-V groove with a 60° included angle. The plates were first flame cut to their 12" x 24" dimensions and then the edges to be welded were machined to the proper configuration. The surfaces of the plates near the weld line were mechanically cleaned in order to remove as much



potential weld contamination as possible. The specimen arrangement and weld joint configuration are shown in Figures 15 and 16 respectively.

## 2. Instrumentation

Strain on the surface of the specimen plates was measured by electric resistance strain gages set at varying transverse distances from the weld line, but at the same longitudinal position. The strain gages consisted of a 90° pair which allowed the simultaneous measurement of longitudinal and transverse strains during welding. The strain gage specifications are contained in Table V and the curve of apparent strain versus temperature for these gages is shown in Figure 14.

Temperature was measured on the surfaces of the specimen plates by use of Chromel/Alumel adhesive bonded thermocouples referenced to 32°F. These thermocouples were positioned at transverse positions from the weld line corresponding to the transverse positions of the strain gages. On the Specimen I HY-130 plate and on the low carbon steel specimen plate, the thermocouples were positioned 0.5 inches ahead of the strain gages. On the Specimen II HY-130 plate, the thermocouples were positioned 1.0 inches ahead of the strain gages. When reducing the



data, the time the welding arc passed the thermocouples was referenced to the time the arc passed the position of the strain gages so that correct corresponding values of temperature and strain were obtained.

Temperature and strain were simultaneously read out on a twelve channel, continuous recording Visicorder. Thermocouple and strain gage locations are indicated in Figures 18 - 21.

#### D. Experiment Procedure

Welding on all tests was performed by the semi-automatic gas-metal-arc method (GMA), using a SVI-300 power supply and associated controls manufactured by the Linde Division of Union Carbide Corporation. Arc travel speed, voltage, and amperage were set prior to the start of welding on each test specimen in order to obtain the desired heat input. Pre-heat was applied by oxygen-acetylene torches and monitored by the installed thermocouples. Interpass temperature was also monitored by the installed thermocouples.

The test plates were lined up with the welding head and tack welded together at one end. The welding head was then moved to the starting end of the weld line and preheat was applied to the plates. When the temperature of



TABLE V  
STRAIN GAGE PROPERTIES

Gage	SR-4 90°
Designation	FAET-18D-12-S6
Manufacturer	BLH Electronics
Grid Dimensions	.19 x .19 inches
Temperature Range	-100 - 500°F
Resistance	120 Ohms
Gage Factor	1.98
Cement	EPY-500





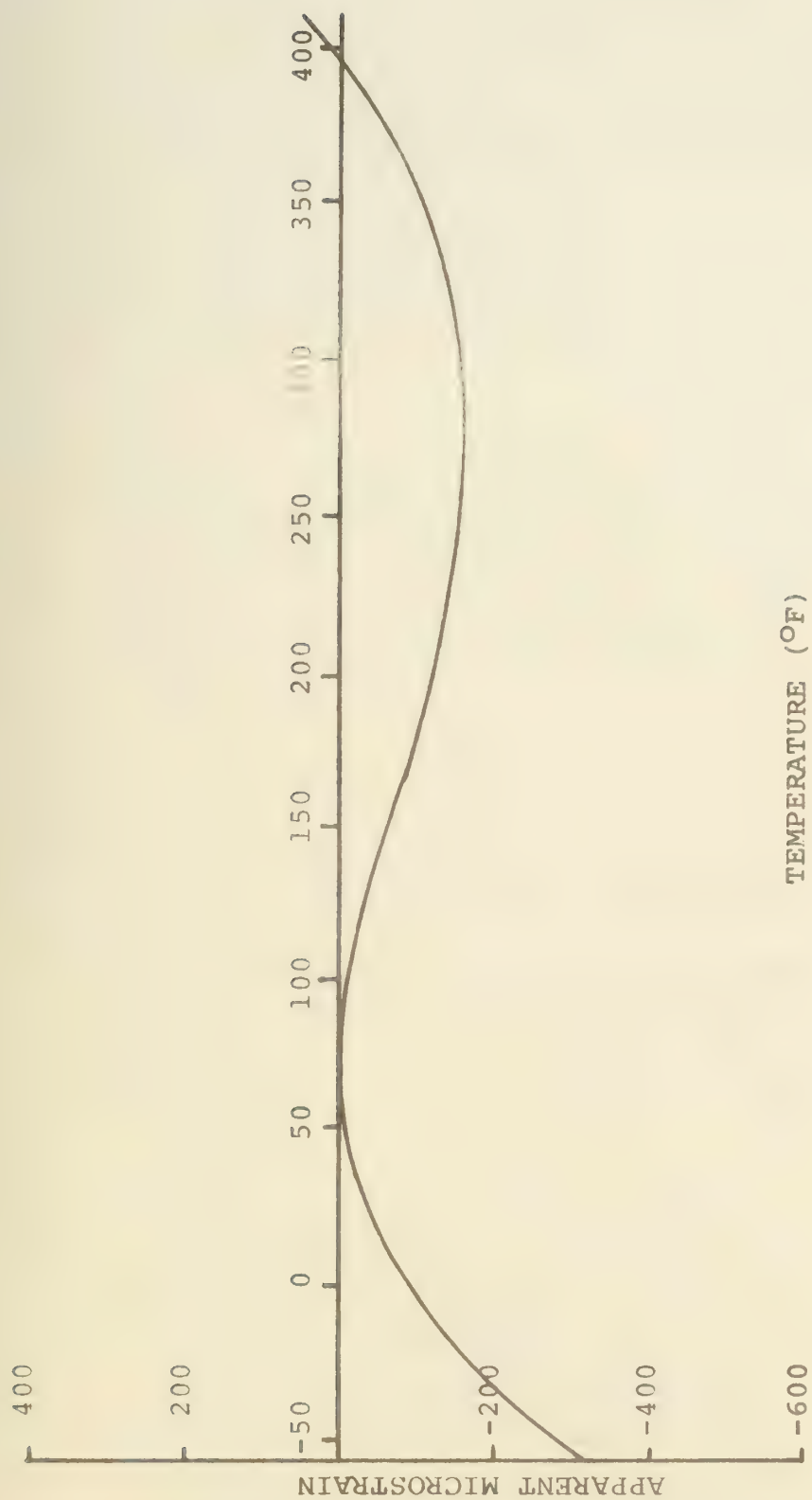


Figure 14 - Effect of Temperature on Apparent Strain 1-4 Strain Gage



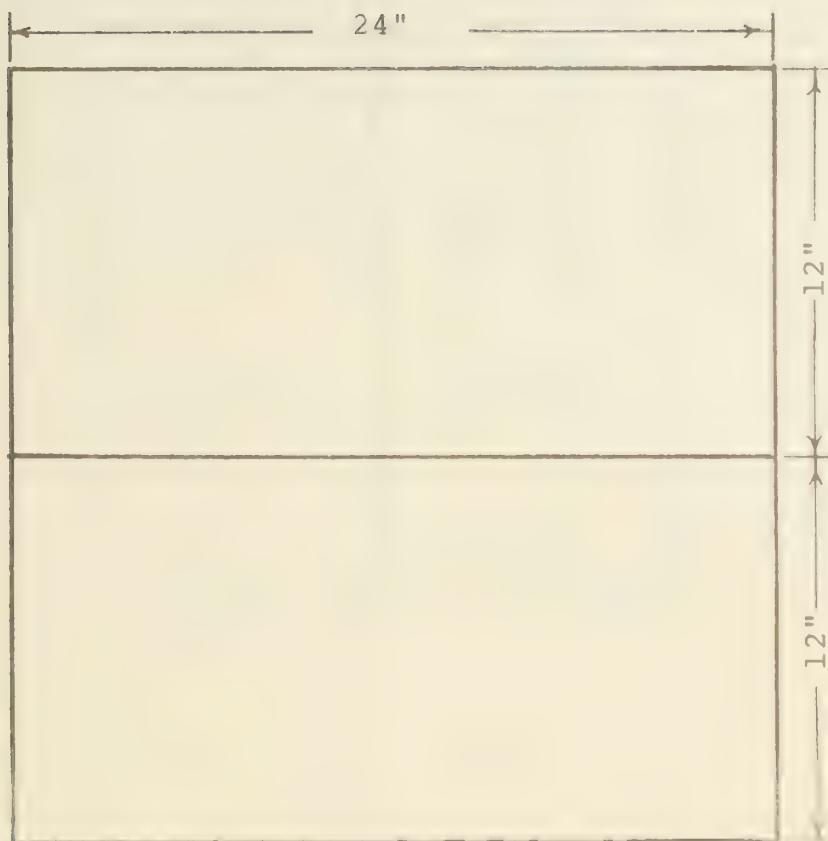


Figure 15 - Test Plate Arrangement

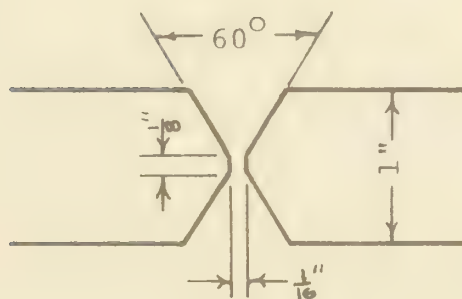


Figure 16 - Weld Joint Configuration



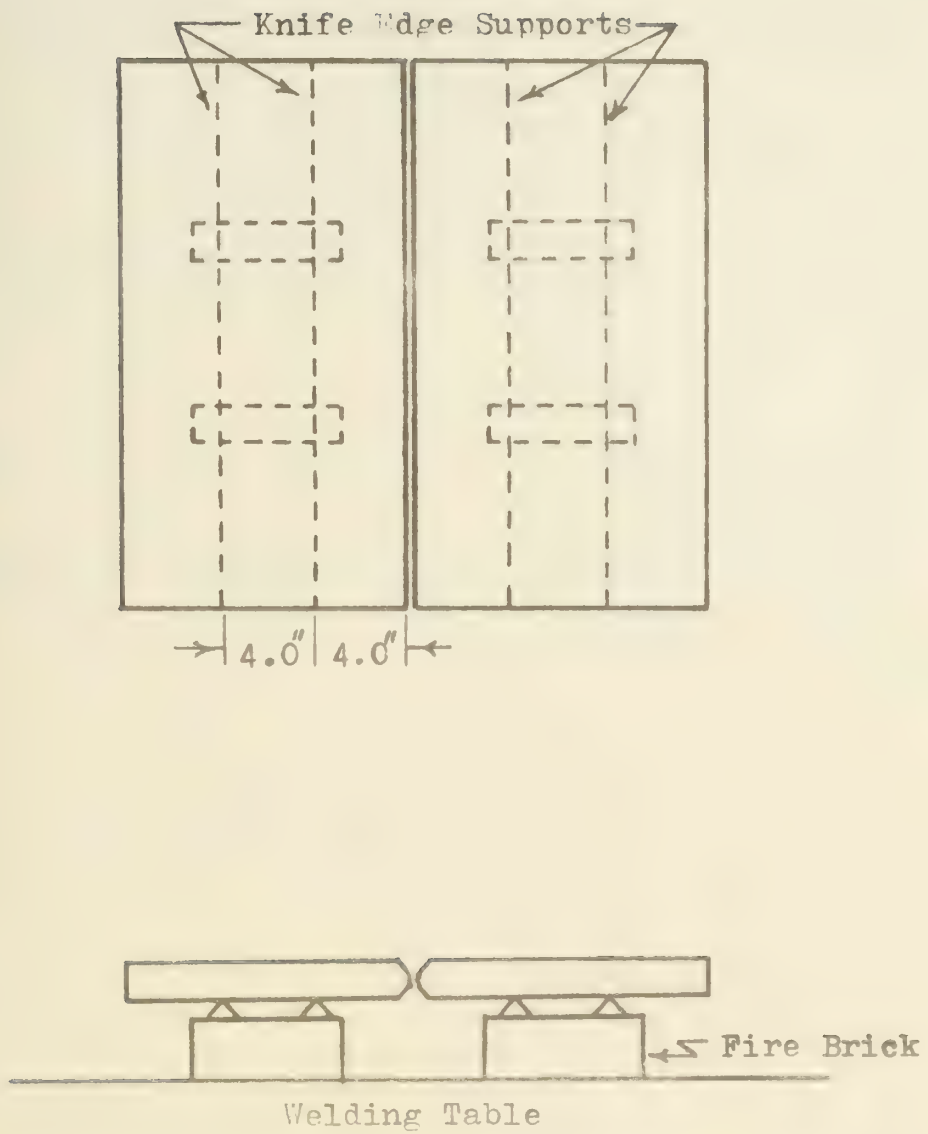


Figure 17 - Test Plate Support Arrangement





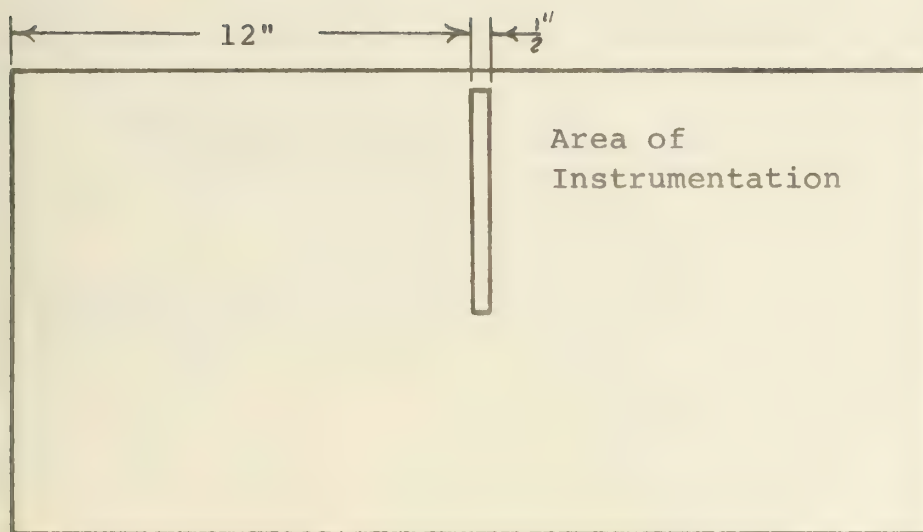


Figure 18 - Location of Instrumentation on HY-130 Specimen I and 1020 Steel

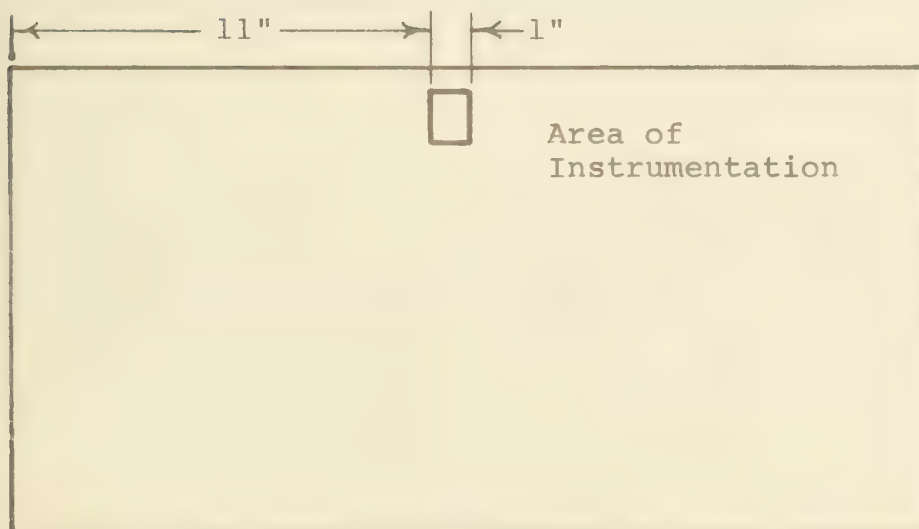


Figure 19 - Location of Instrumentation on HY-130 Specimen II



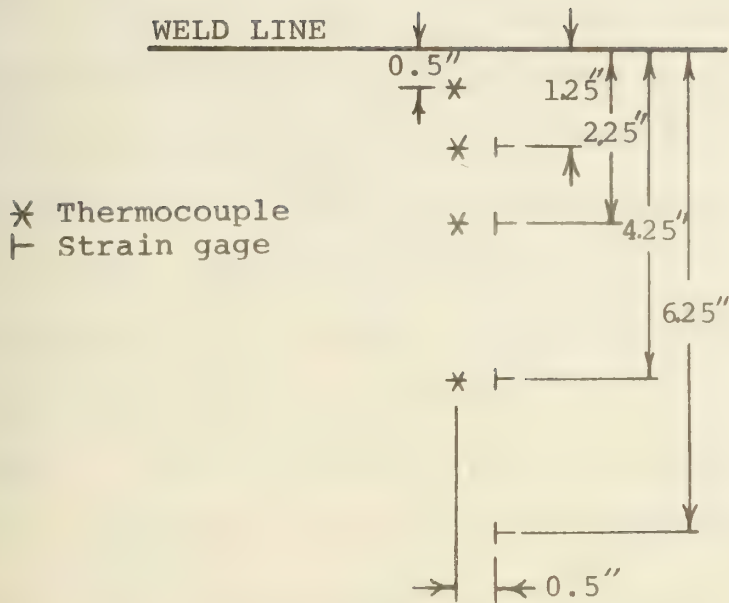


Figure 20 - Thermocouple and Strain Gage Location on HY-130 Specimen I and 1020 Steel

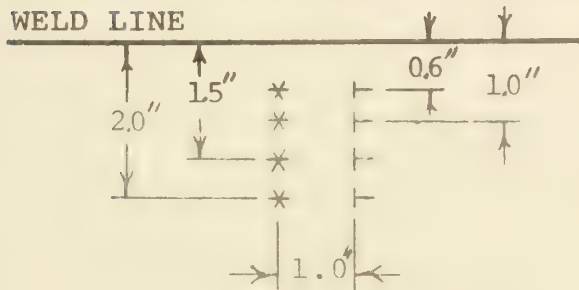


Figure 21 - Thermocouple and Strain Gage Location on HY-130 Specimen II



the test specimen, as measured by the thermocouples, averaged between 150°F and 175°F, the visicorder was actuated and an arc was struck to begin the first pass. When the arc reached the end of the weld line, it was extinguished and the welding head was returned to the starting point. The visicorder continued to record temperatures and strains continuously for approximately one minute and then intermittently until the next pass was to be made. The test specimen air cooled until the desired interpass temperature range of 150°F-175°F was reached as measured by the thermocouple nearest the weld line. At this point the visicorder was actuated, the arc struck, and the process repeated for the next pass. This procedure was repeated for each of the six passes needed to fill the upper half of the double-V groove. After the completion of the sixth pass, the test specimen was allowed to cool to room temperature. Welding conditions are summarized in Table VI.



TABLE VI

TEST PLATE	1020	HY-130 SPECIMEN I	HY-130 SPECIMEN II
WELD TYPE	BUTT	BUTT	BUTT
PROCESS	GMA	GMA	GMA
ARC VOLTS	26	25	25
POLARITY	DCRP	DCRP	DCRP
TRAVEL SPEED (rpm)	12	12	12
HEAT INPUT (Kjoules/in)	39	37	37
FILLER WIRE	.0625" A-675	0.045" Linde-140	0.045" Linde-140
SHIELDING GAS	AR, 25% CO <sub>2</sub>	AR, 2% O <sub>2</sub>	AR, 2% O <sub>2</sub>
NUMBER OF PASSES	6	6	6
PREHEAT & INTER PASS TEMP.	150-175°F	150-175°F	150-175°F

WELDING CONDITIONS





## CHAPTER IV

### RESULTS

#### A. Presentation of Data

The experimental results are presented as measurements of longitudinal strain versus time for the strain results and temperature versus time for the temperature measurements. The time axis refers to the time elapsed from the start of one pass until the start of the next pass. The time scales for each pass have been adjusted and the data is presented so that the arc passes the point of observation at the time of 40 seconds. This point is marked on each graph. This manipulation of time scales is permissible because there is minimal movement in either temperature or strain during the first 20 seconds of each pass. Note the change in scale at 100 seconds to that of a log plot from 100 to 1000 seconds. Temperature is measured in degrees Fahrenheit. Longitudinal strain is presented as units of microstrain, which equals  $10^{-6}$  in/in.

Figures 22 through 31 present the experimental mechanical strain results for HY-130. First, the results for Specimen I are presented with the longitudinal strain measured at 1.25", 2.25", and 4.25" from the weld line presented in a graph for each of the passes 2-6. The strain and temperature movement measured at 6.25" were



minimal and therefore are not presented. The results for Specimen II are then presented, with the longitudinal strain measured at 1.0", 1.5", and 2.0" from the weld line shown on graphs for passes 2-6. The longitudinal strain measurements at 0.6" from the weld line on Specimen II are shown in Figure 32. These were separated from the other HY-130 results because of the uniqueness of the curves. The results shown are for passes 2, 3, and 4. Pass 4 is very similar to pass 3 and the results for pass 6 are unreliable because the temperature of the strain gage greatly exceeded the maximum allowable temperature of the gage for a significant amount of time.

Figures 33 through 37 present the experimental mechanical strain results for 1020 steel. The longitudinal strain measured at 1.25", 2.25", and 4.25" from the weld line are presented together for each pass, 2-6. The strain measured at 6.25" from the weld line was insignificant and therefore not presented.

Figures 38 through 46 show comparisons between experimental results and predictions by the one-dimensional computer program for both temperature and longitudinal strain. The results shown are for pass 3 and are entirely representative of the comparisons for the other passes. The results for HY-130, both measured and predicted at



1.0", 1.25", 2.0", 2.25", and 4.25" from the weld line, are presented as well as the results for 1020 steel at 1.25", 2.25", and 4.25" from the weld line.



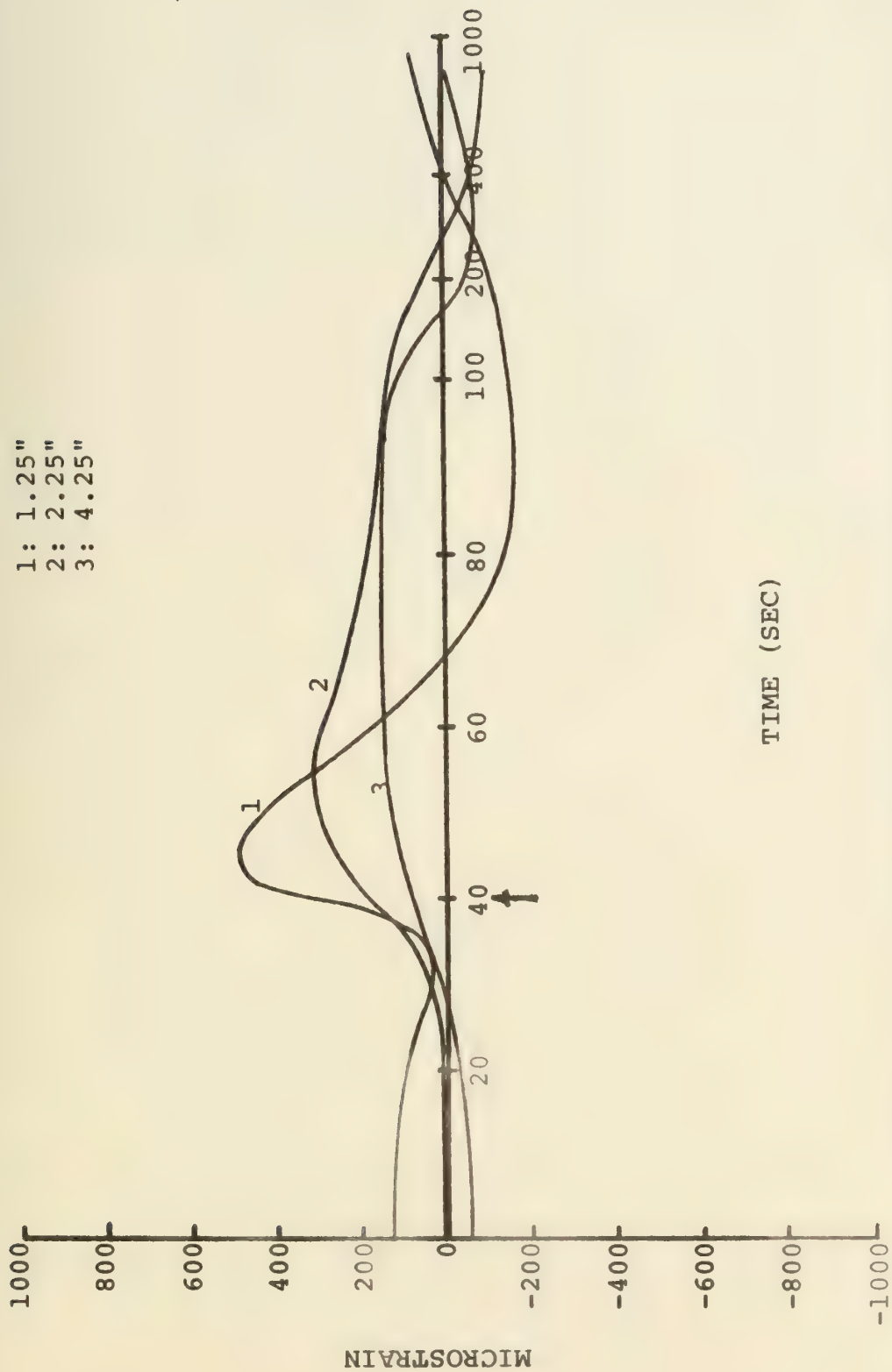


Figure 22 - HY-130 Specimen I, Experimental Results, Pass 2





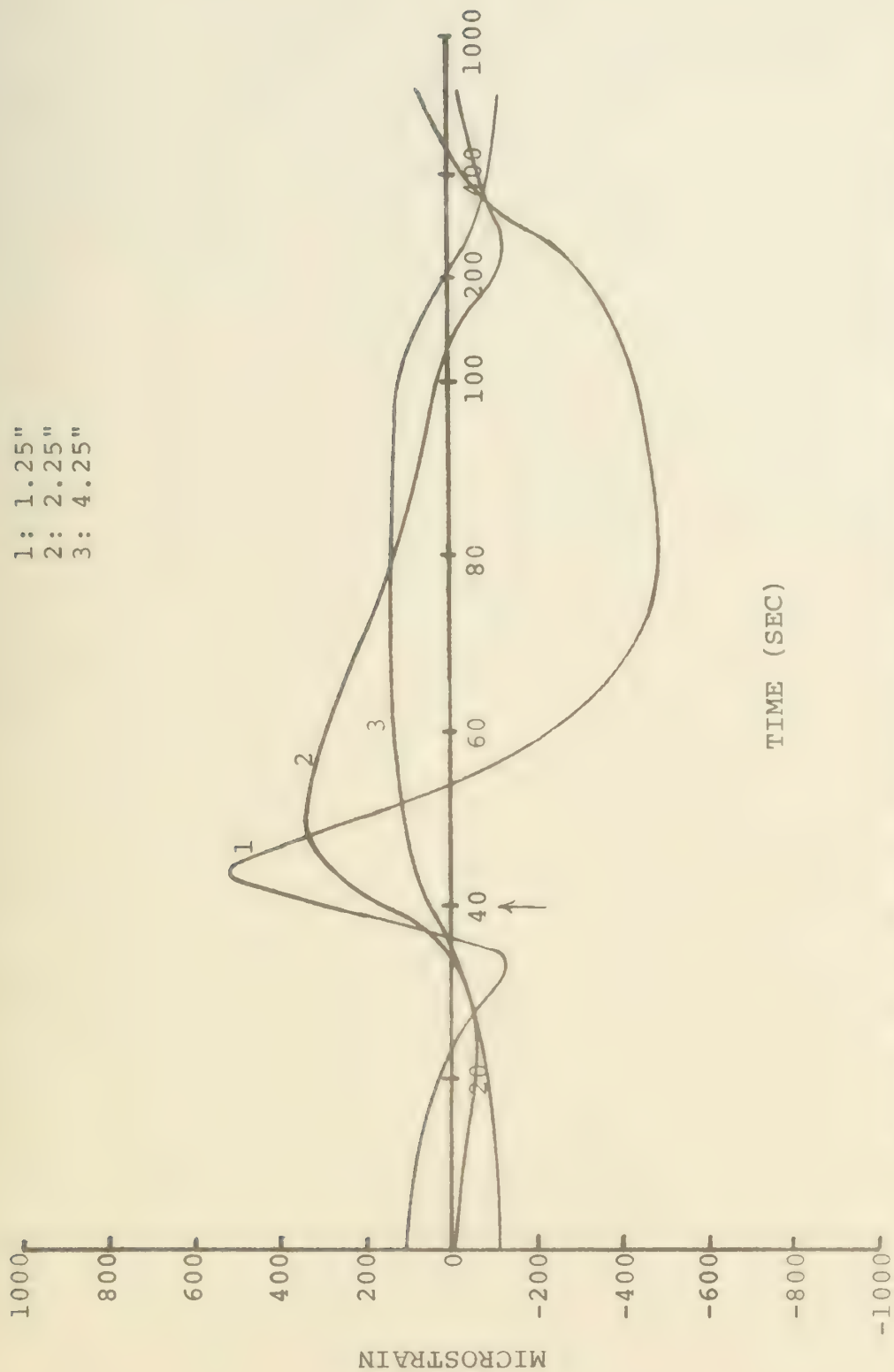


Figure 23 - HY-130 Specimen I, Experimental Results, Pass 3



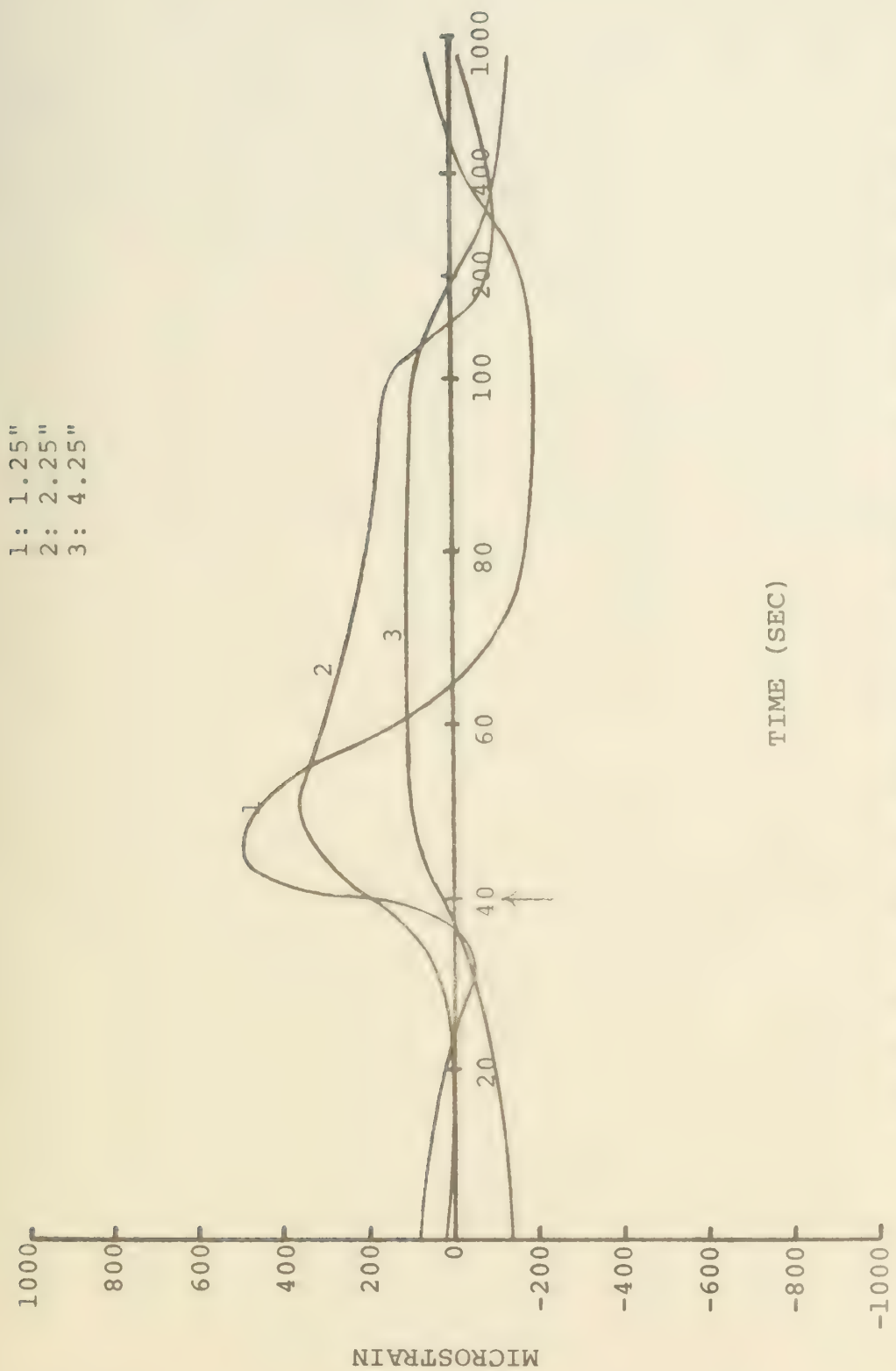


Figure 24 - HY-130 Specimen I, Experimental Results, Pass 4



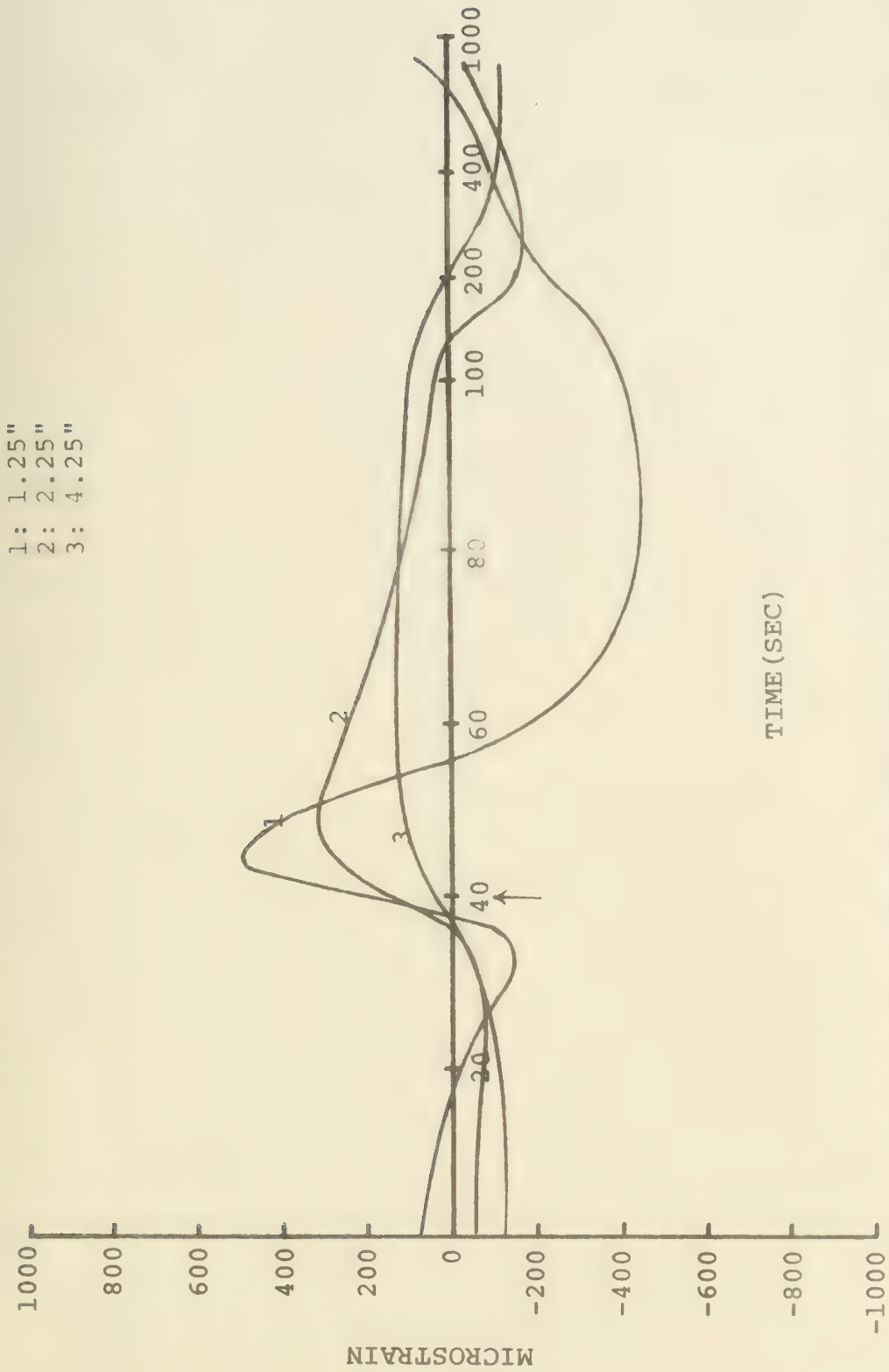


Figure 25 - HY-130 Specimen 1, Experimental Results, Pass 5



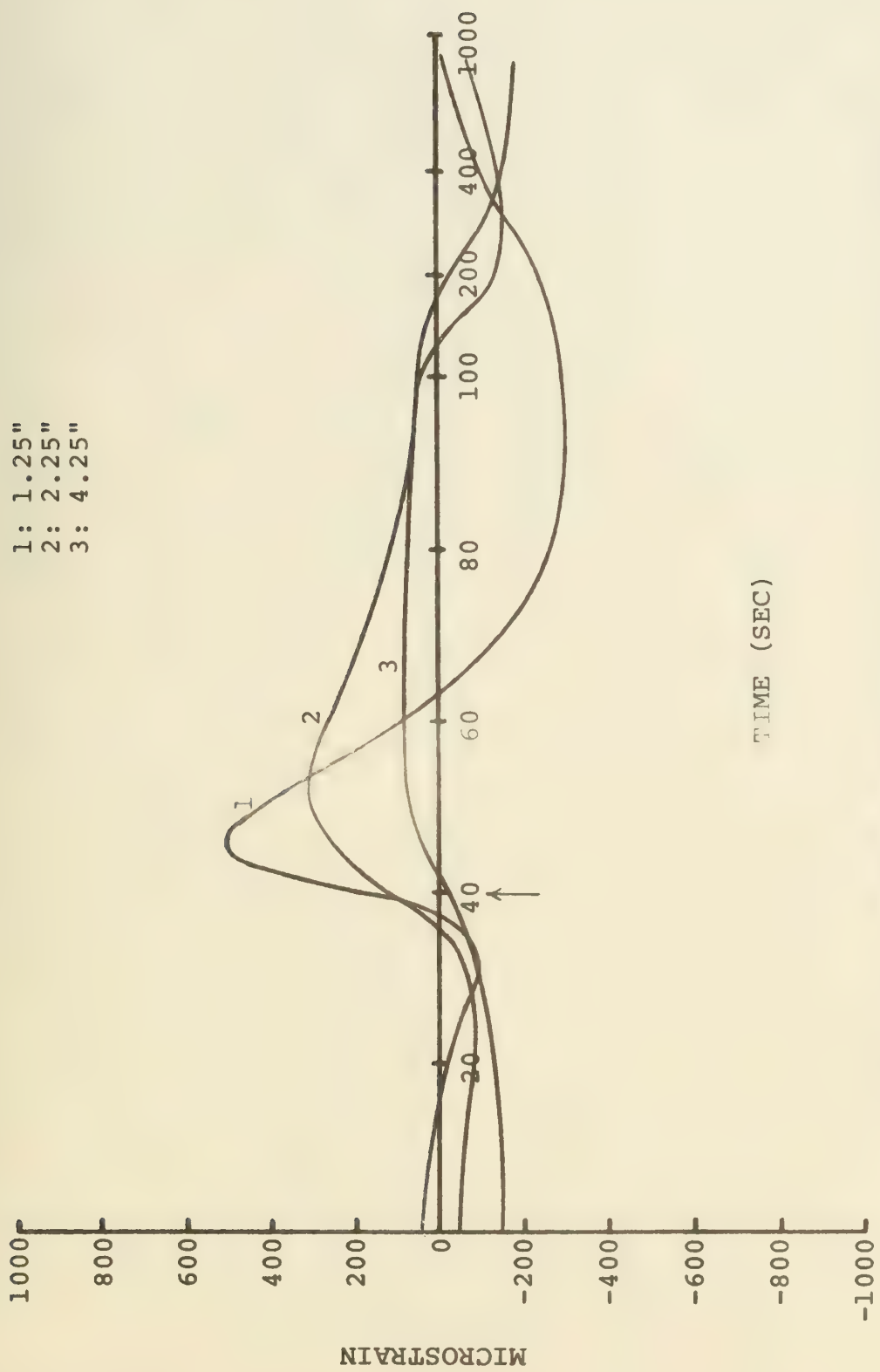


Figure 26 - HY-130 Specimen I, Experimental Results, Pass 6





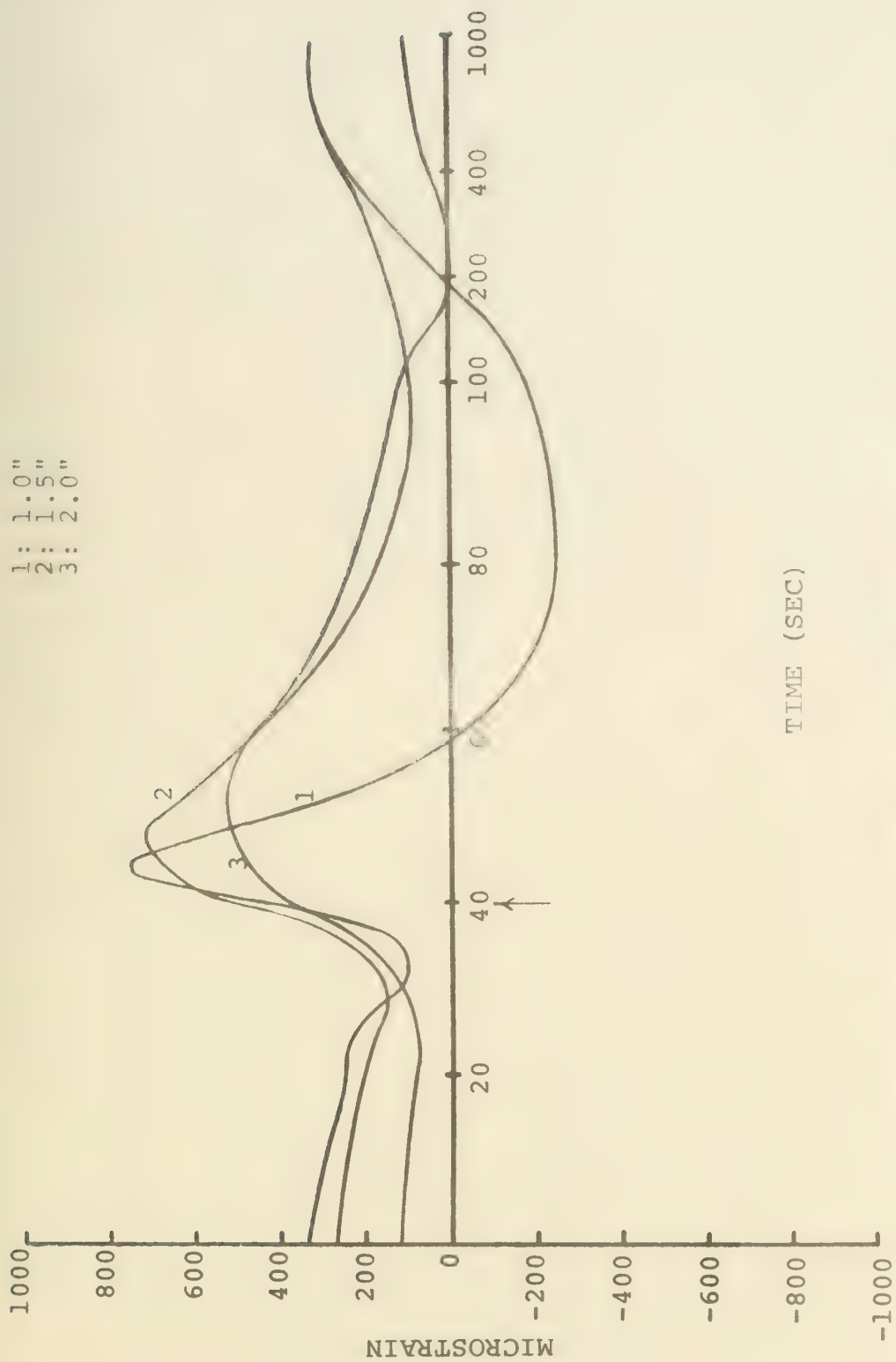


Figure 27 - HY-130 Specimen II, Experimental Results, Pass 2



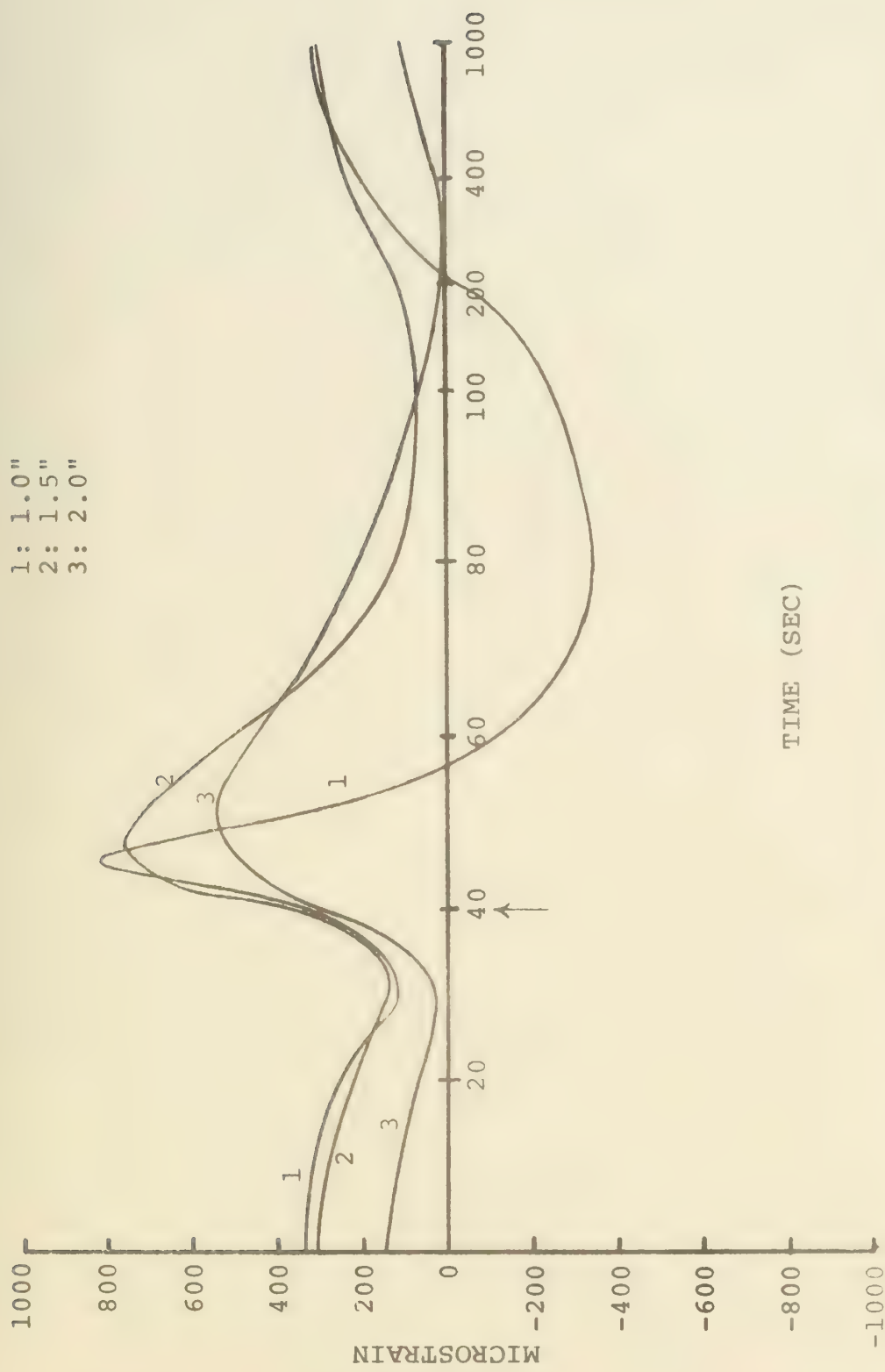


Figure 28 - HY-130 Specimen II, Experimental Results, Pass 3







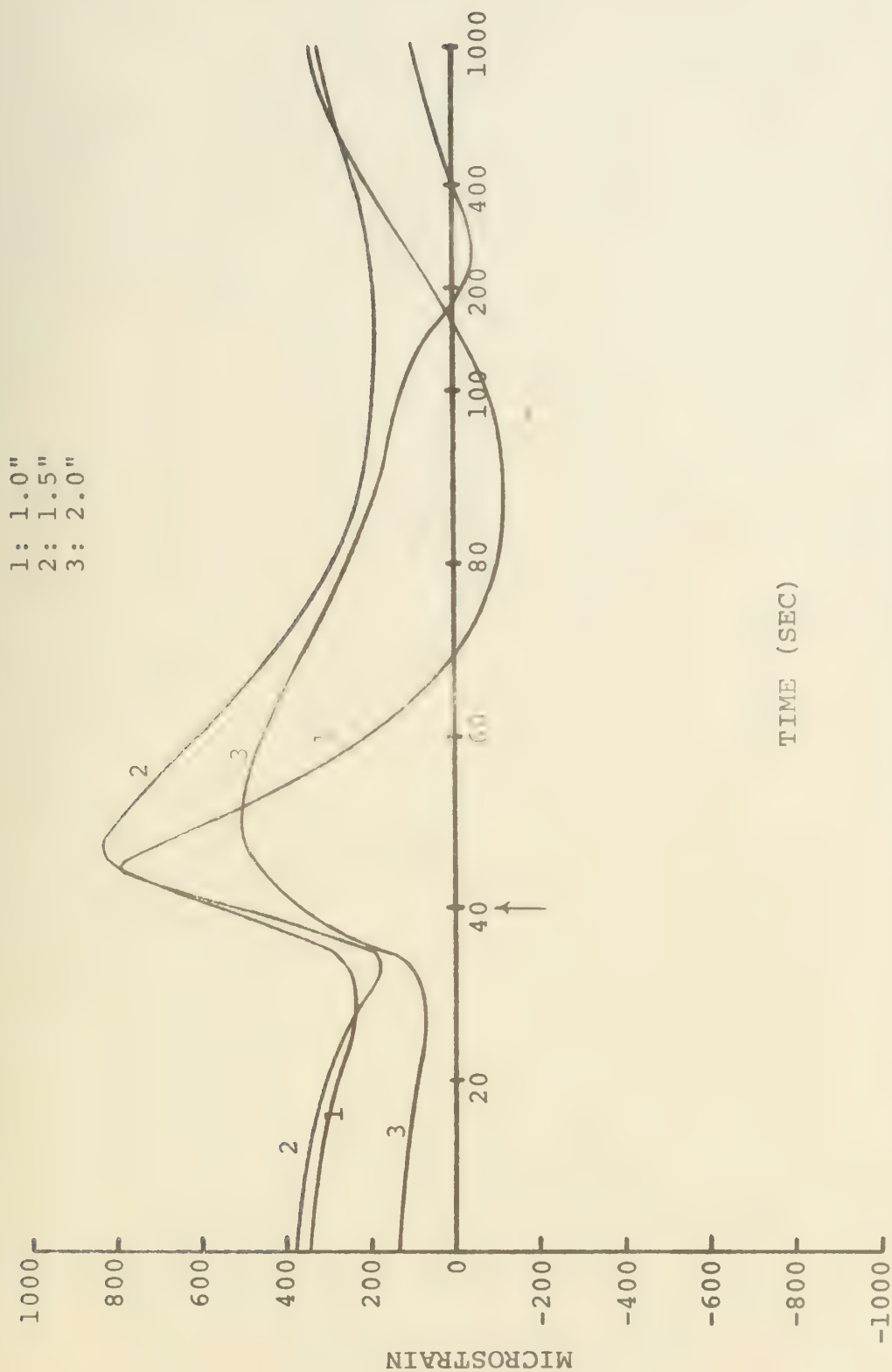


Figure 30 - HY-130 Specimen II, Experimental Results, Pass 5





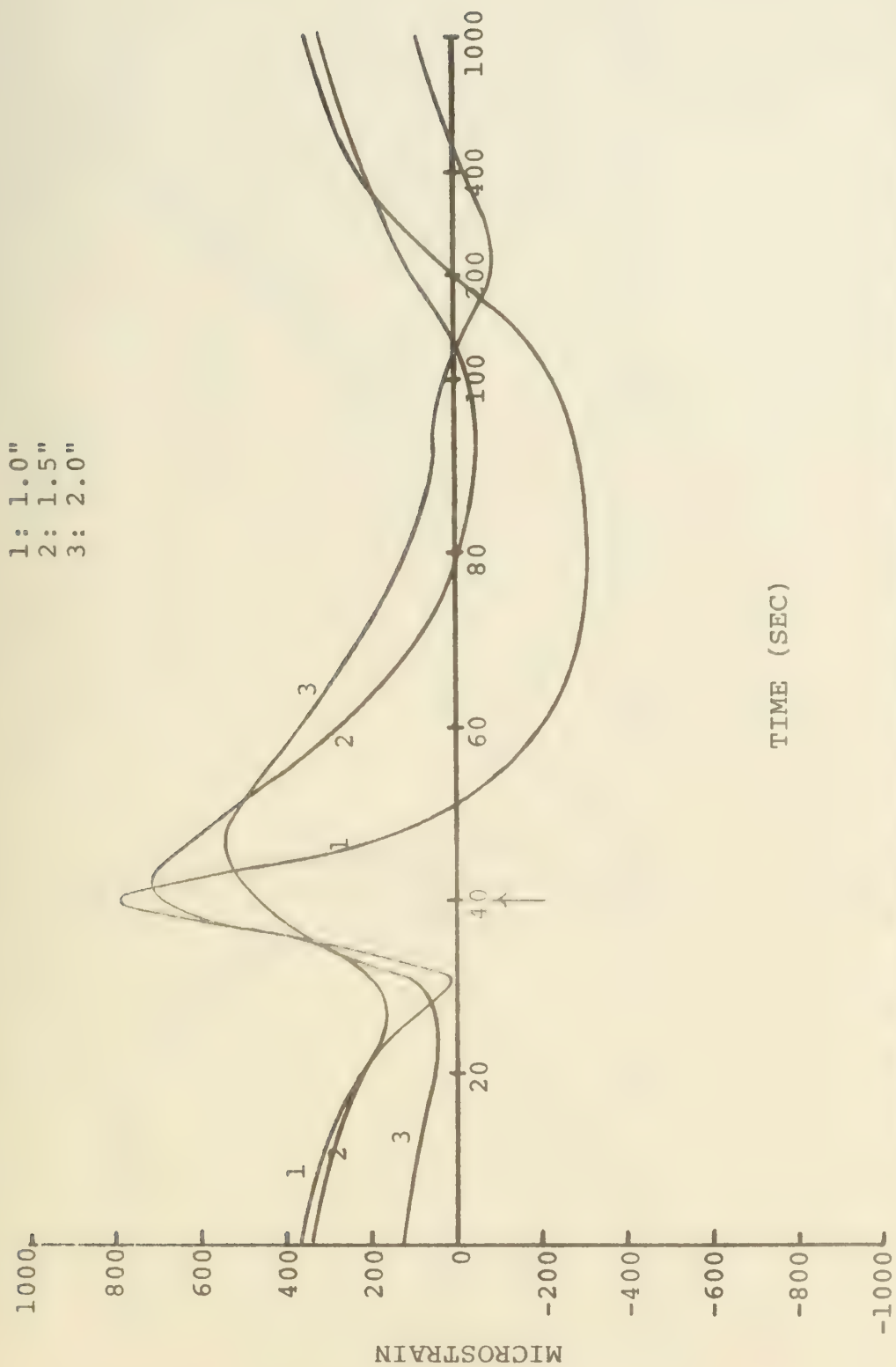


Figure 31 - HY-130 Specimen II, Experimental Results, Pass 6



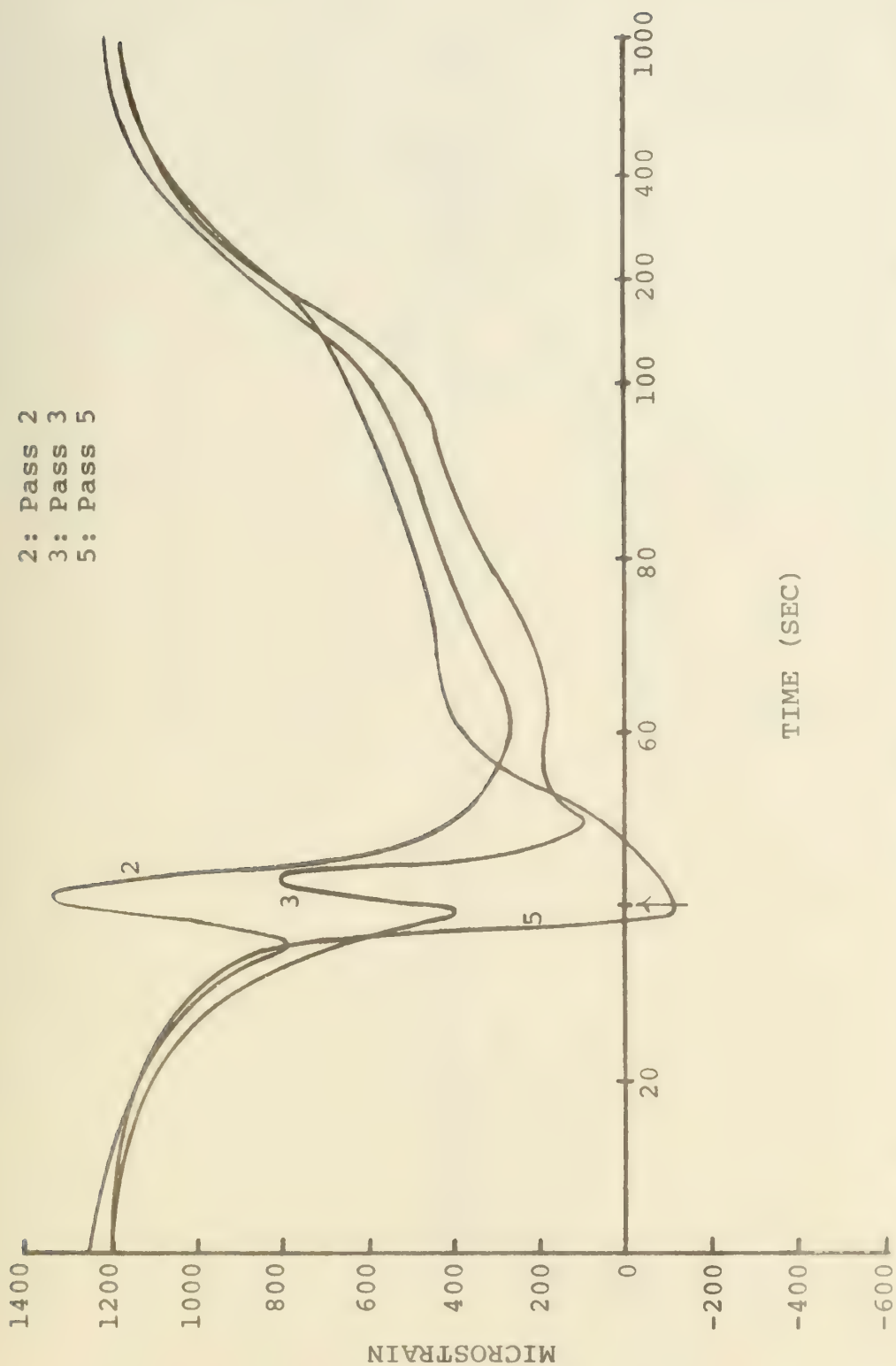


Figure 32 - HY-130 Specimen II, Experimental Results at 0.6" from Weld Line



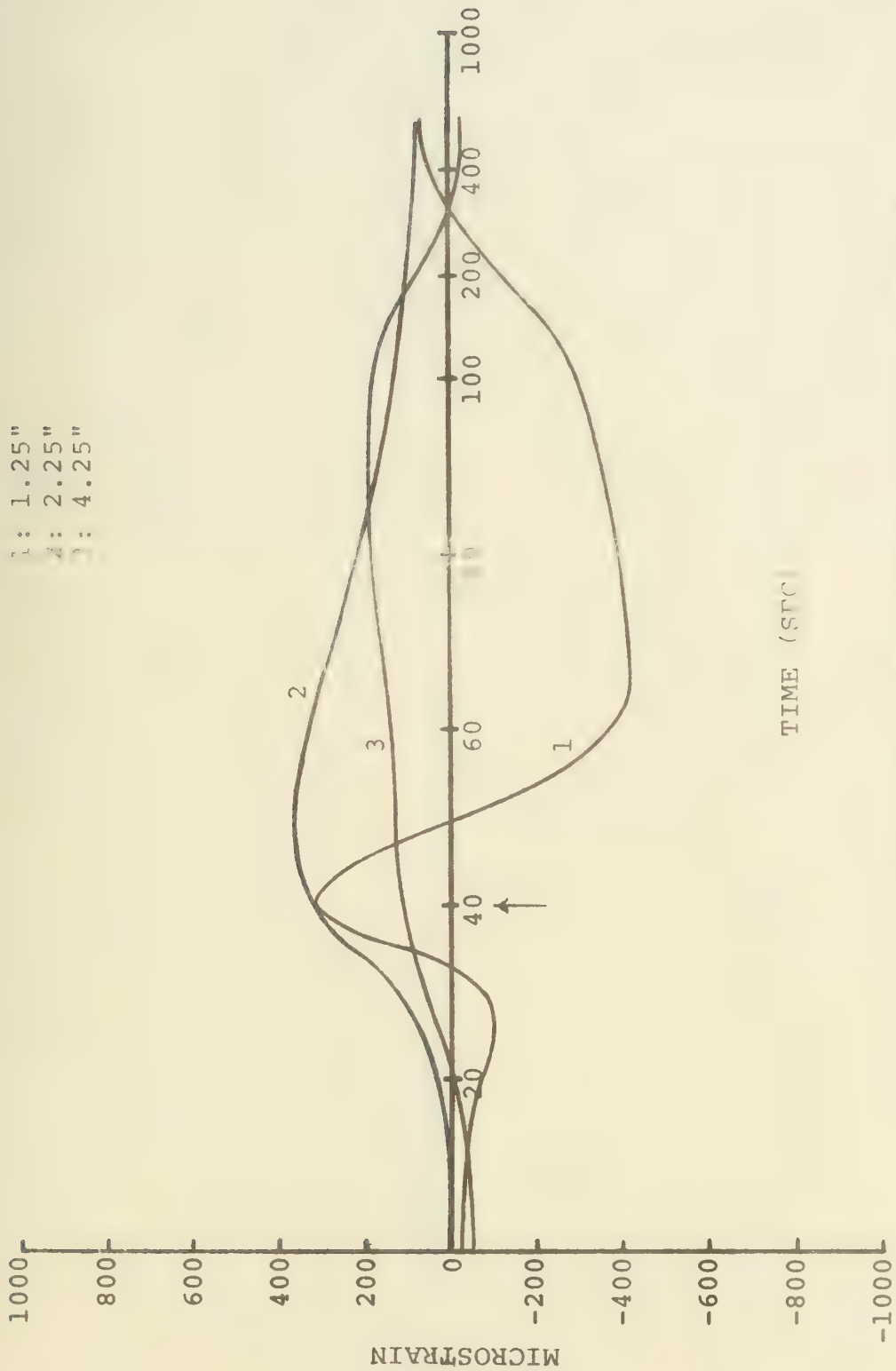


Figure 33 - 1020 Steel, Experimental Results, Pass 2



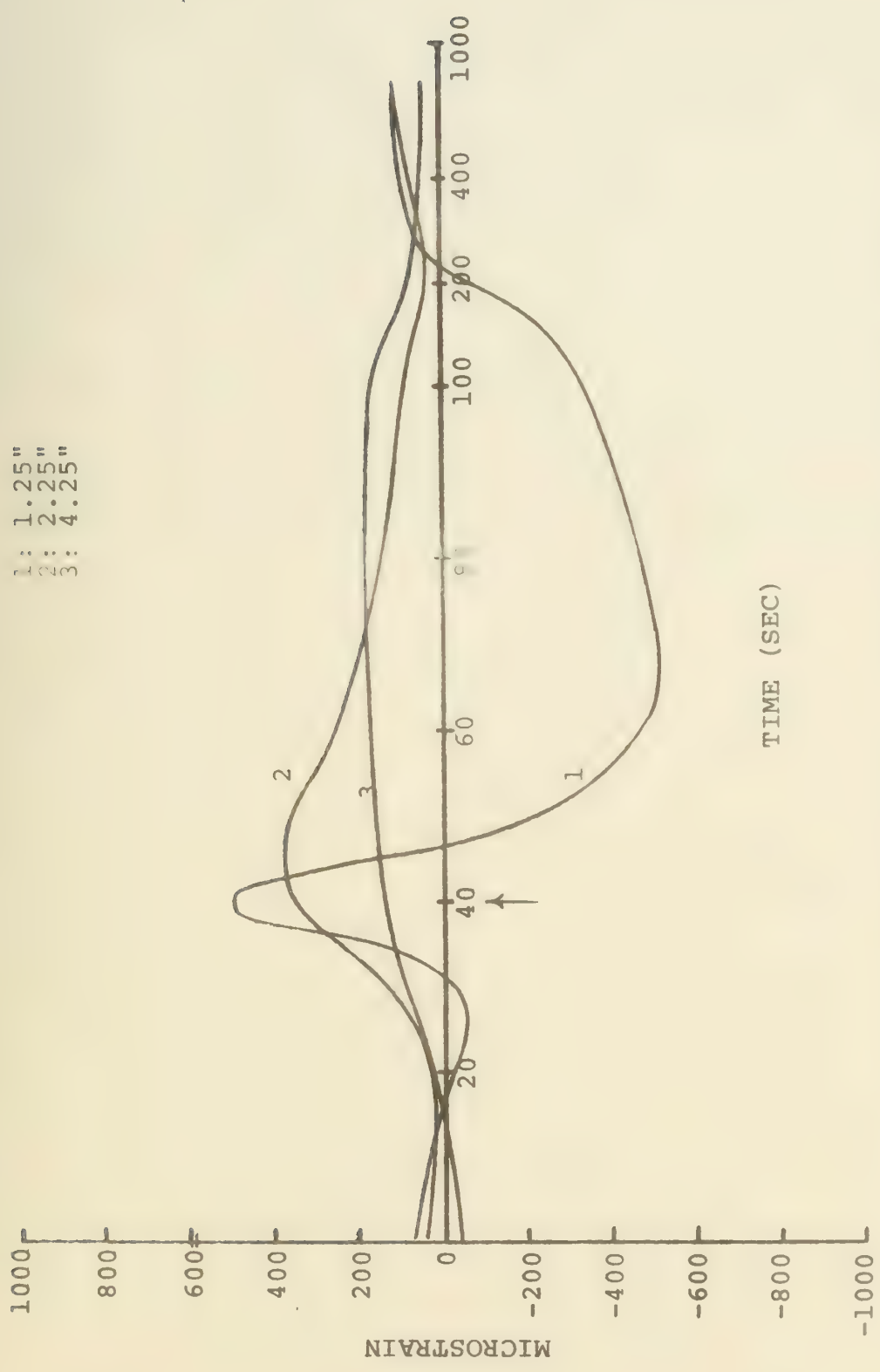


Figure 34 - 1020 Steel, Experimental Results, Pass 3





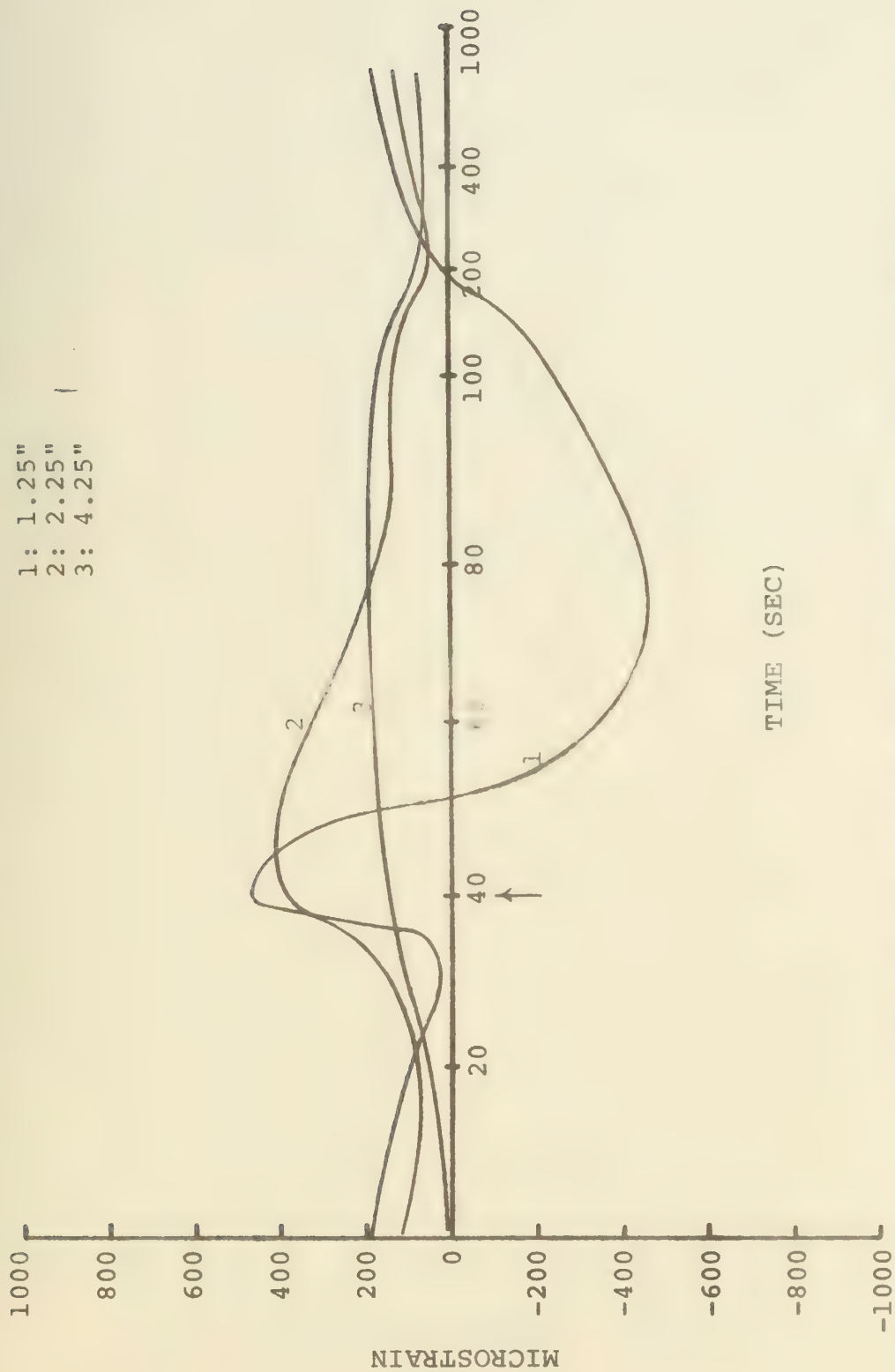


Figure 35 - 1020 Steel, Experimental Results, Pass 4



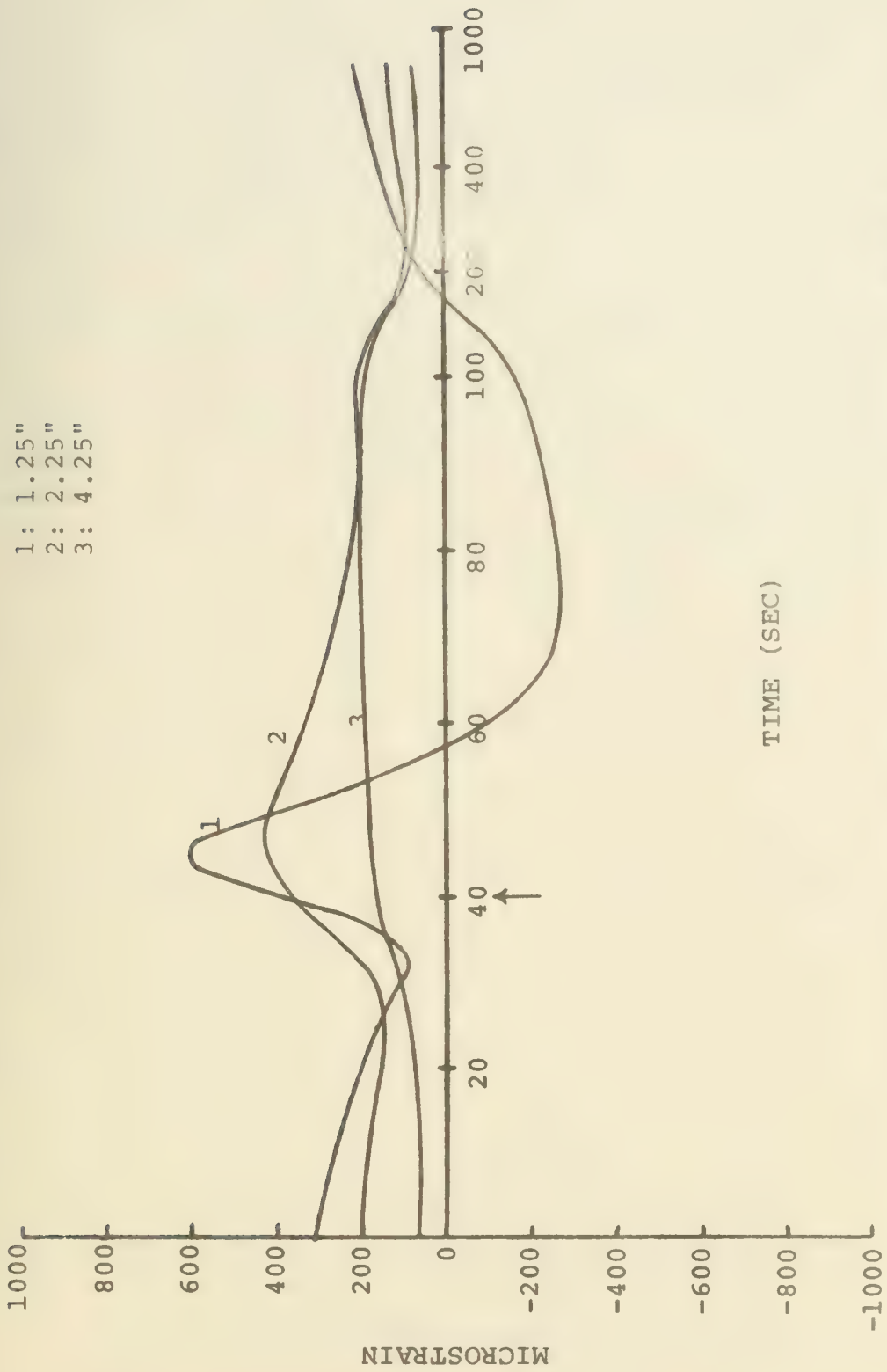


Figure 36 - 1020 Steel, Experimental Results, 5



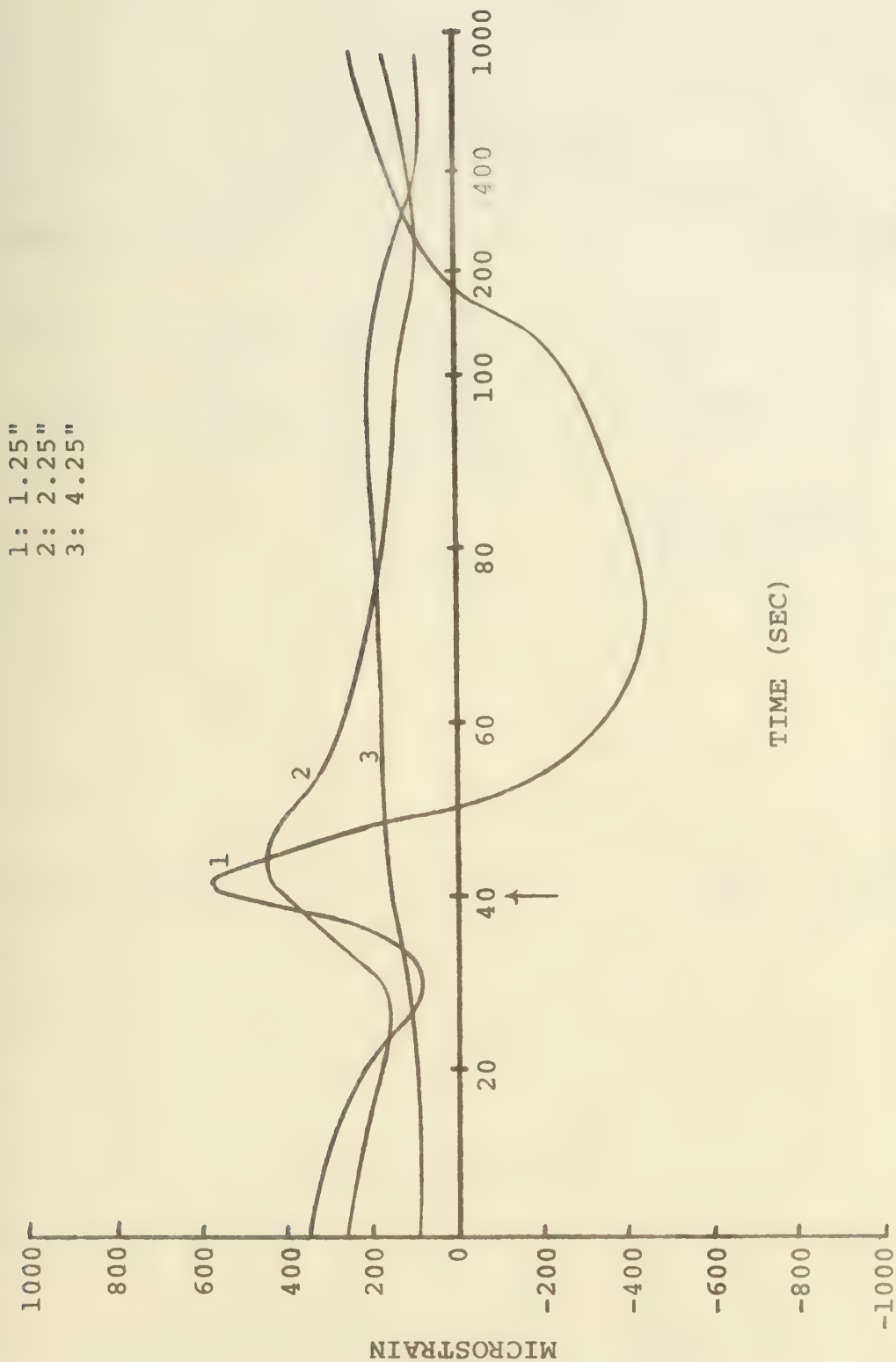
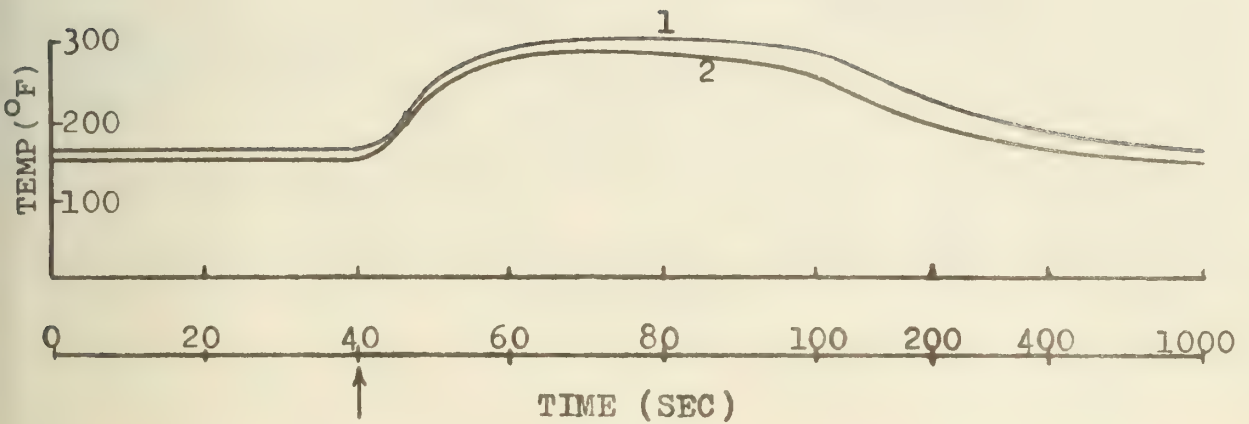


Figure 37 - 1020 Steel, Experimental Results, Pass 5





1: Experiment  
2: Computer

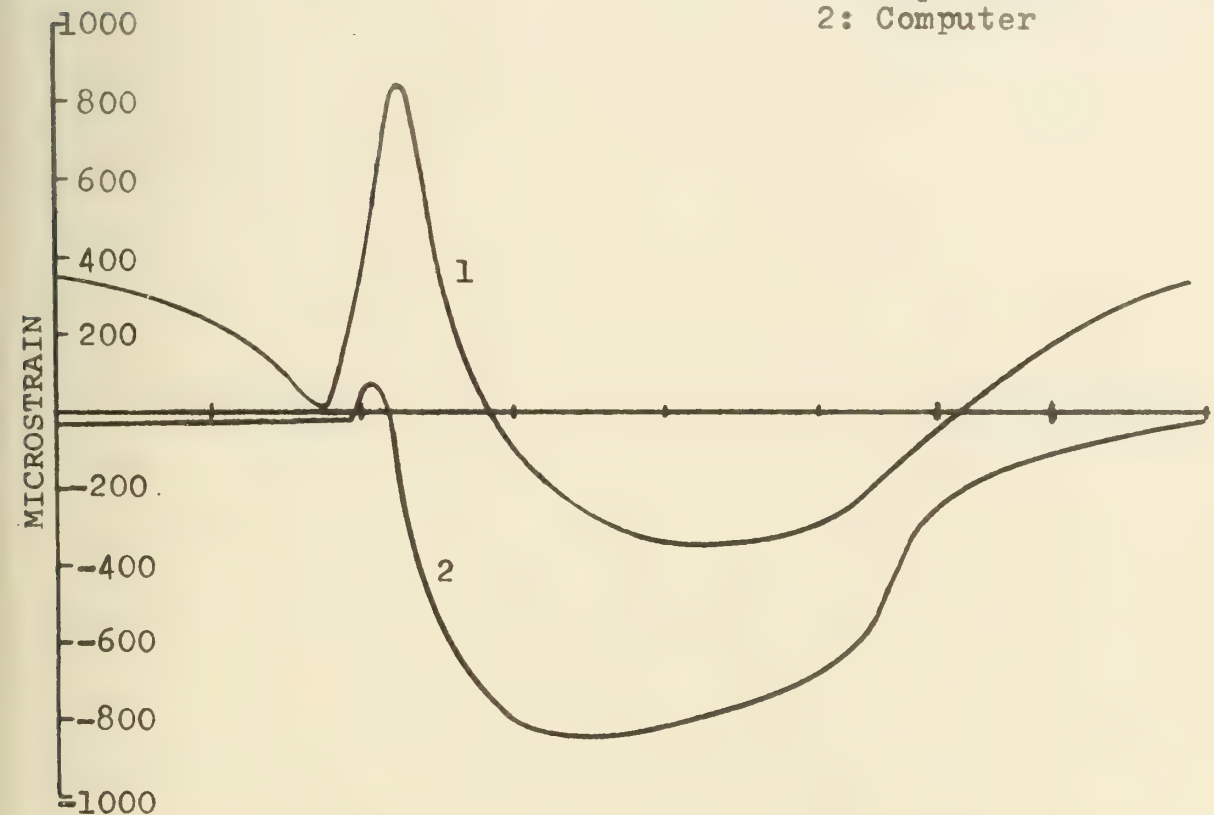


Figure 38 - HY-130 Specimen II, 1.0", Temperature and Strain Analytical Comparison, Pass 3





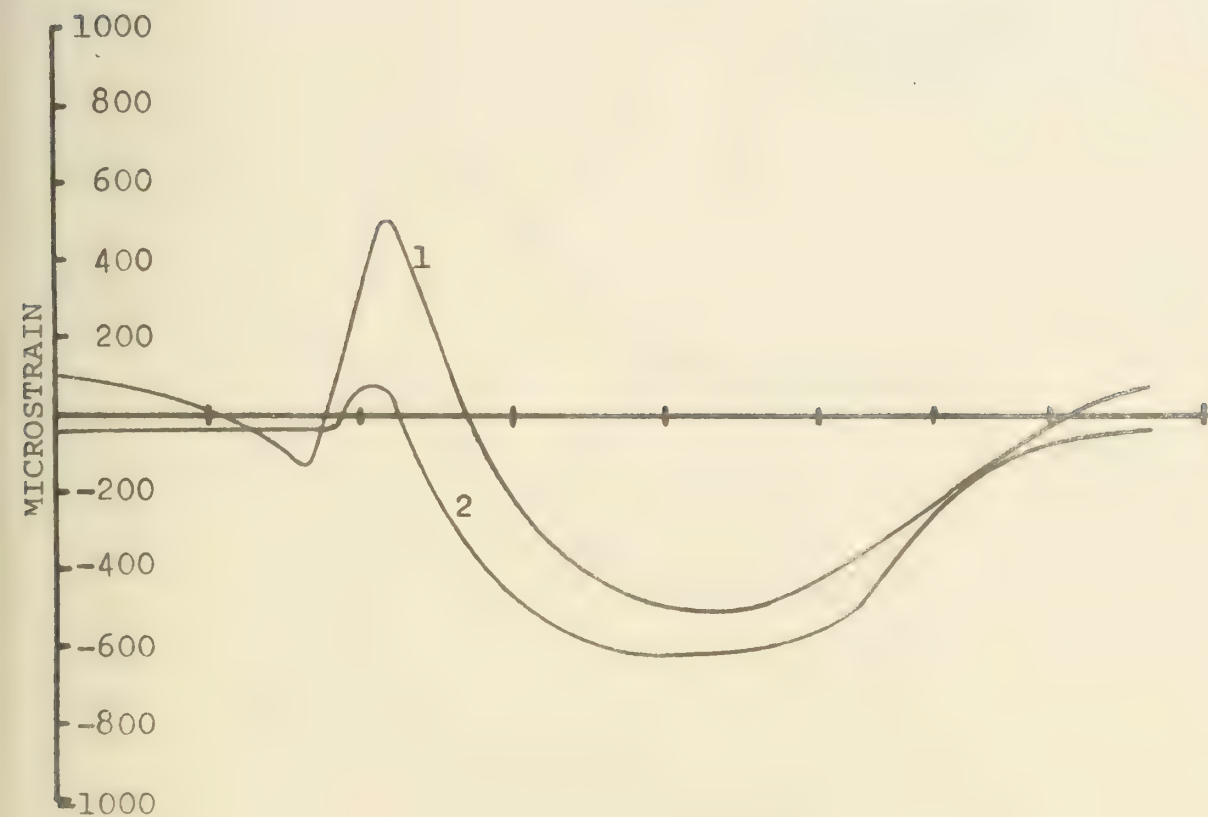
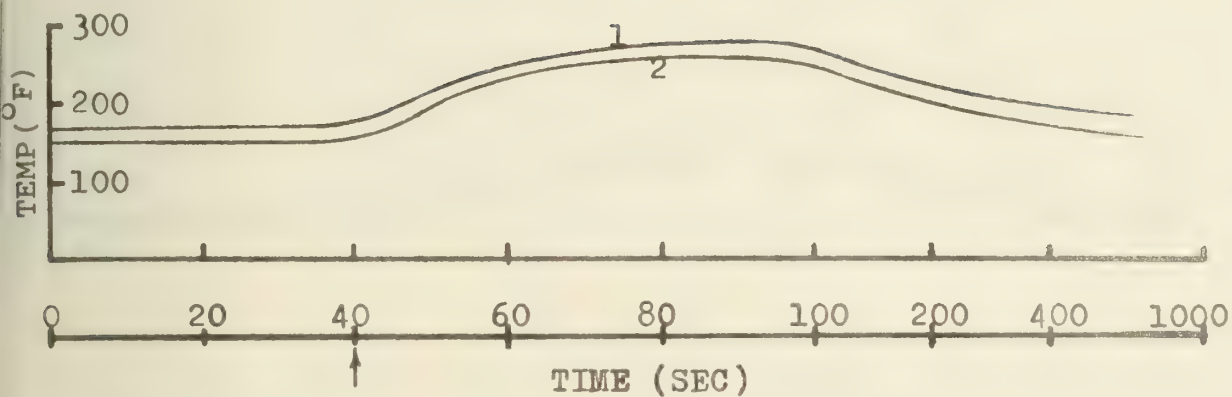


Figure 39 - HY-130 Specimen I, 1.25", Temperature and Strain Analytical Comparison, Pass 3



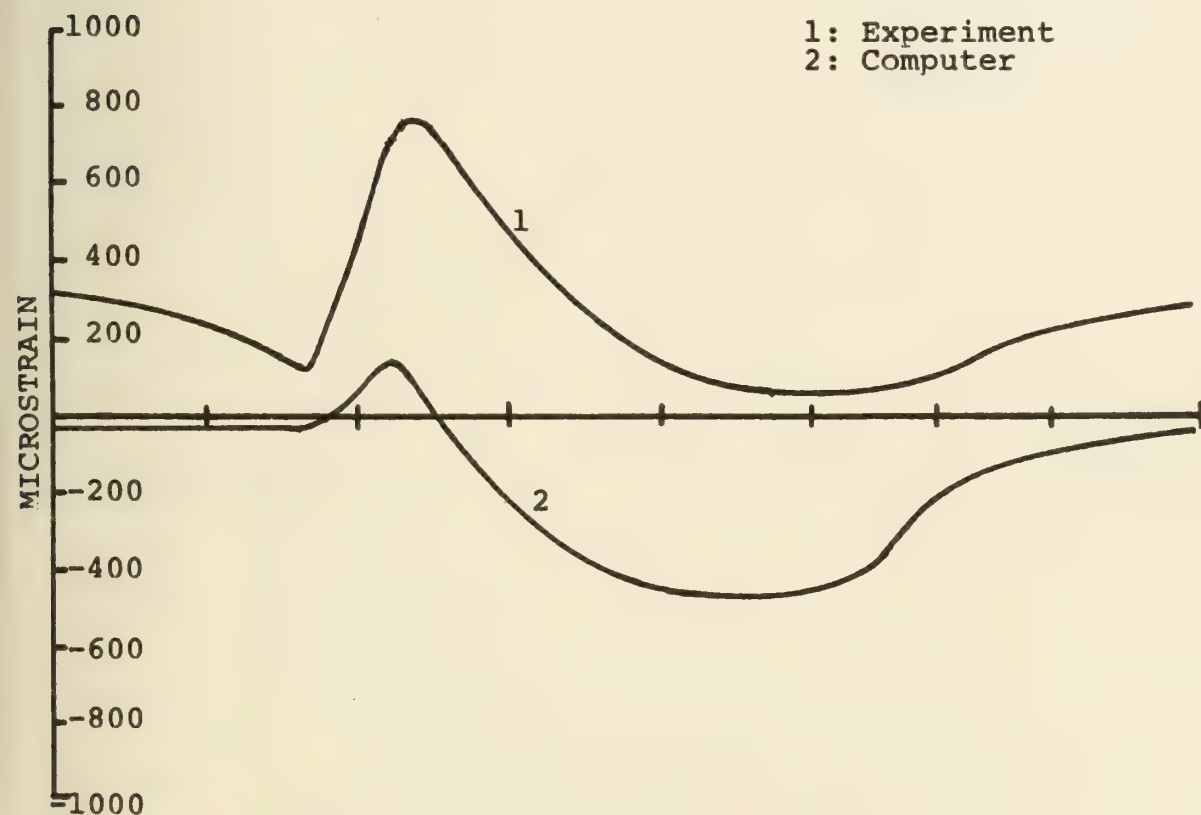
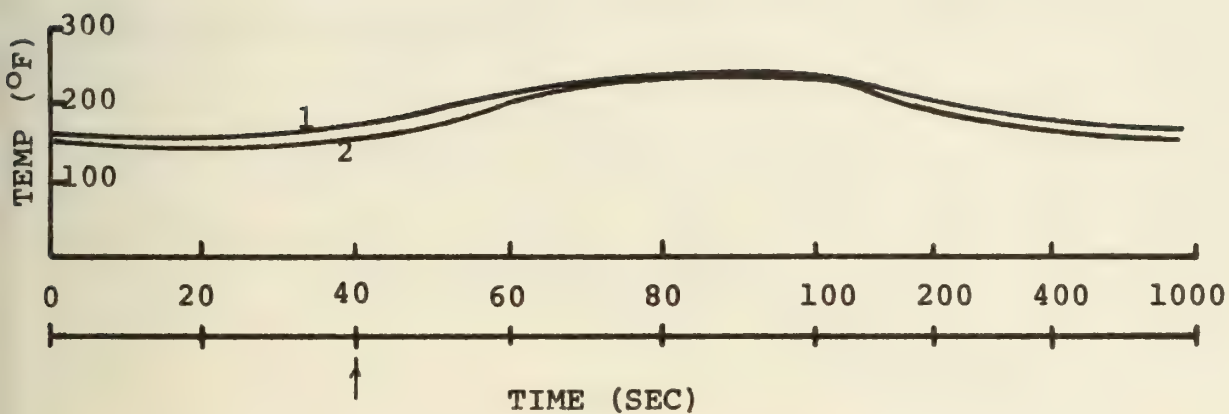


Figure 40 - HY-130 Specimen II, 1.5", Temperature and Strain Analytical Comparison, Pass 3



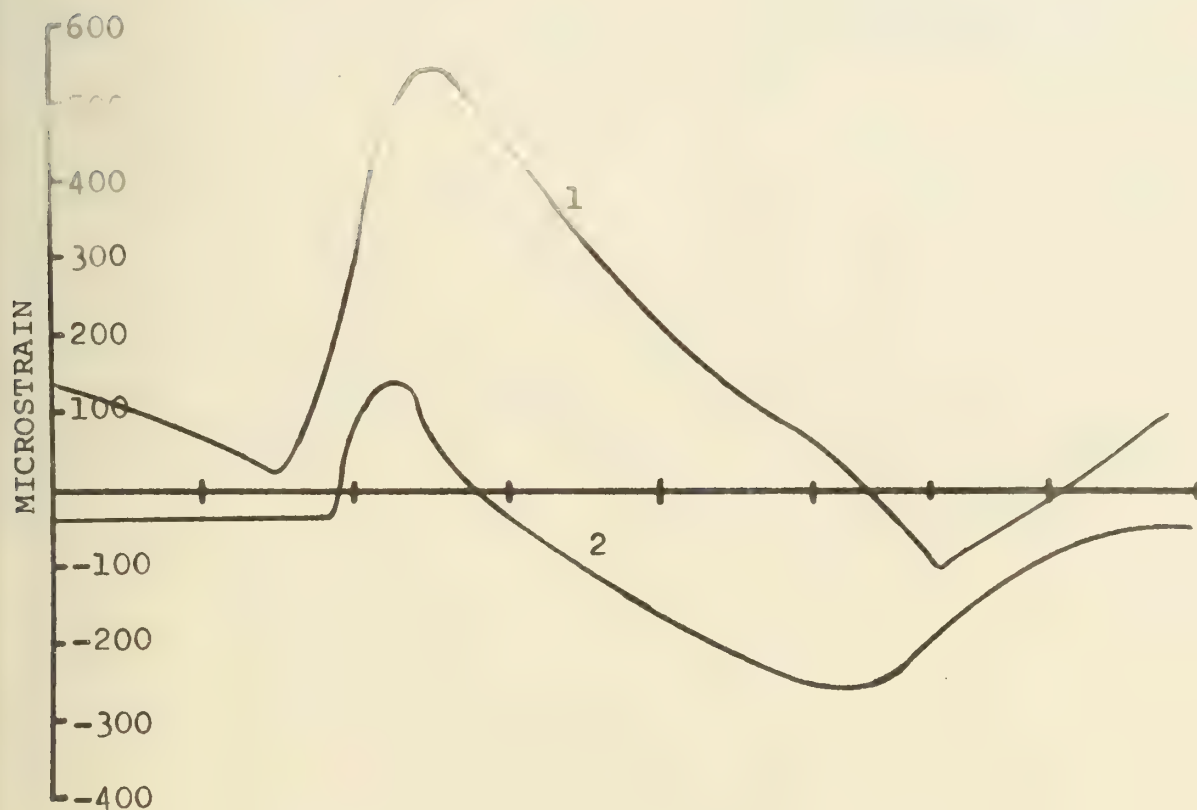
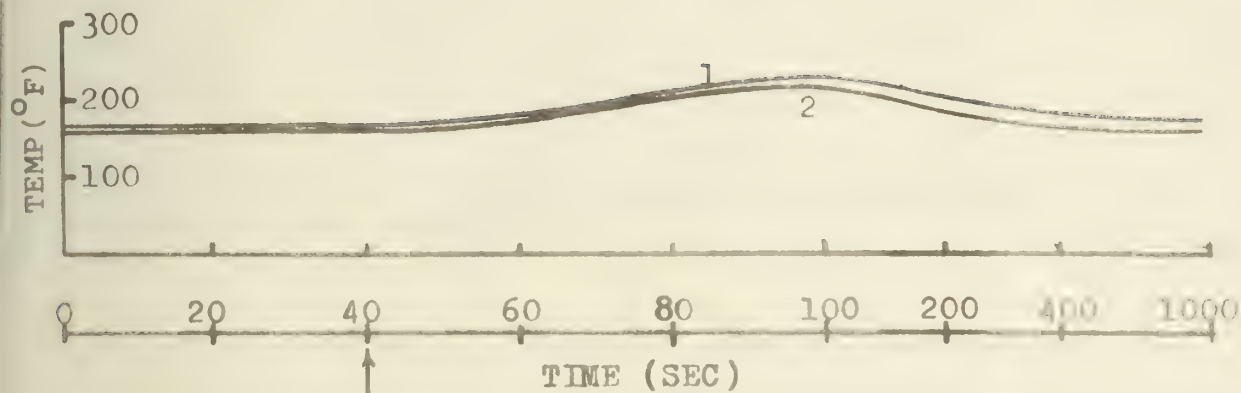
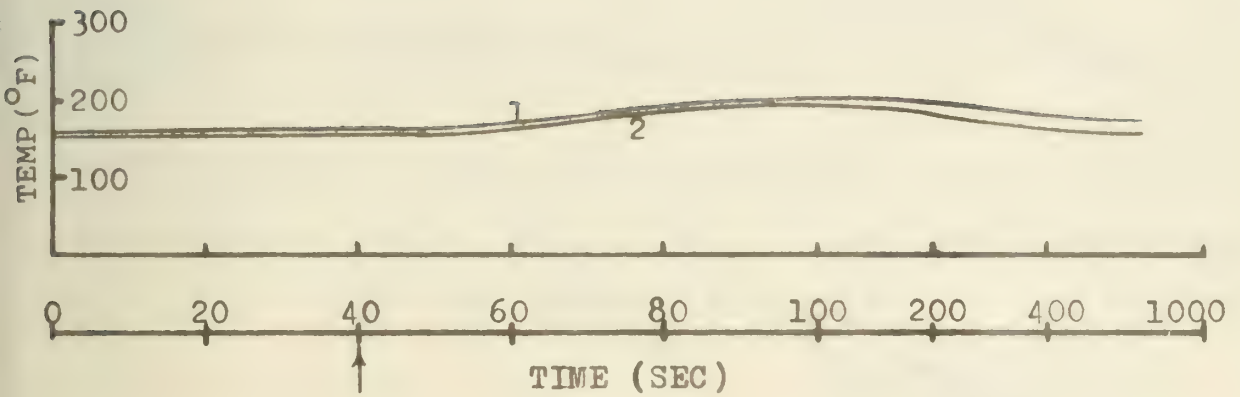


Figure 41 - HY-130 Specimen II, 2.0", Temperature and Strain Analytical Comparison, Pass 3





1: Experiment  
2: Computer

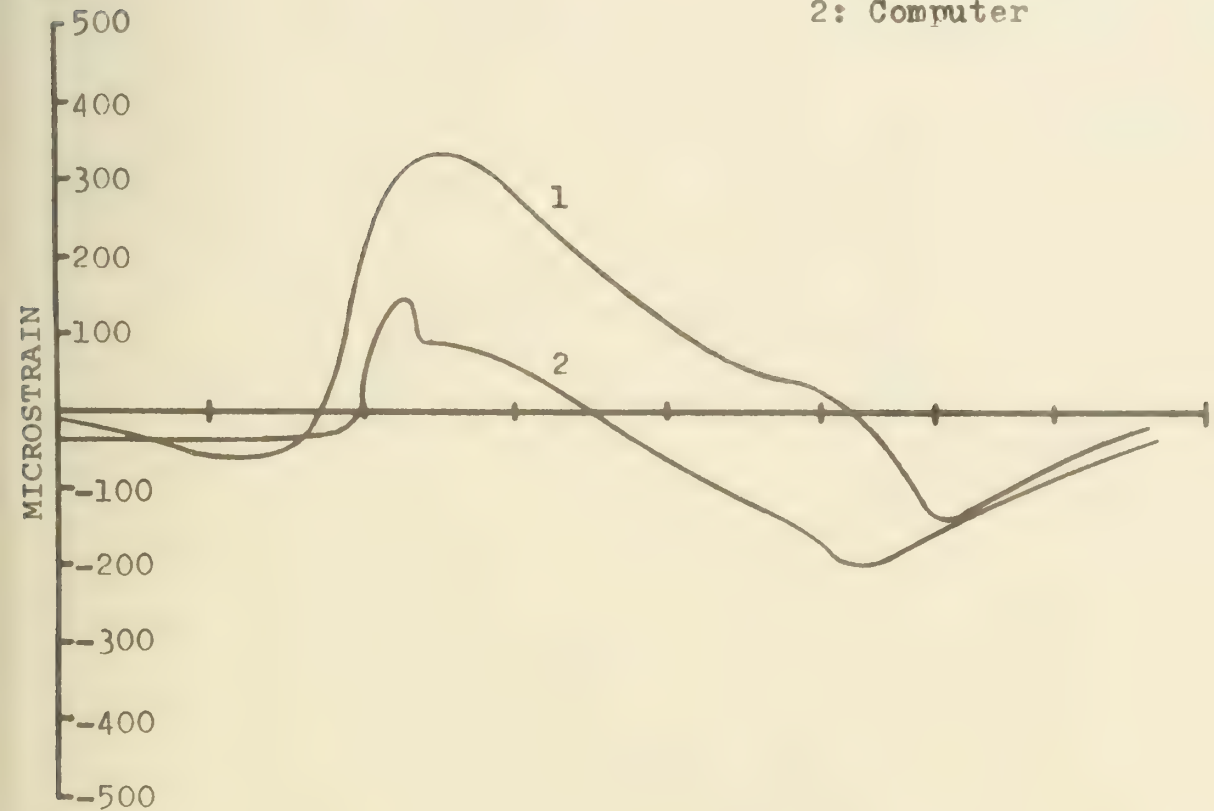


Figure 42 - HY-130 Specimen I, 2.25", Temperature and Strain Analytical Comparison, Pass 3





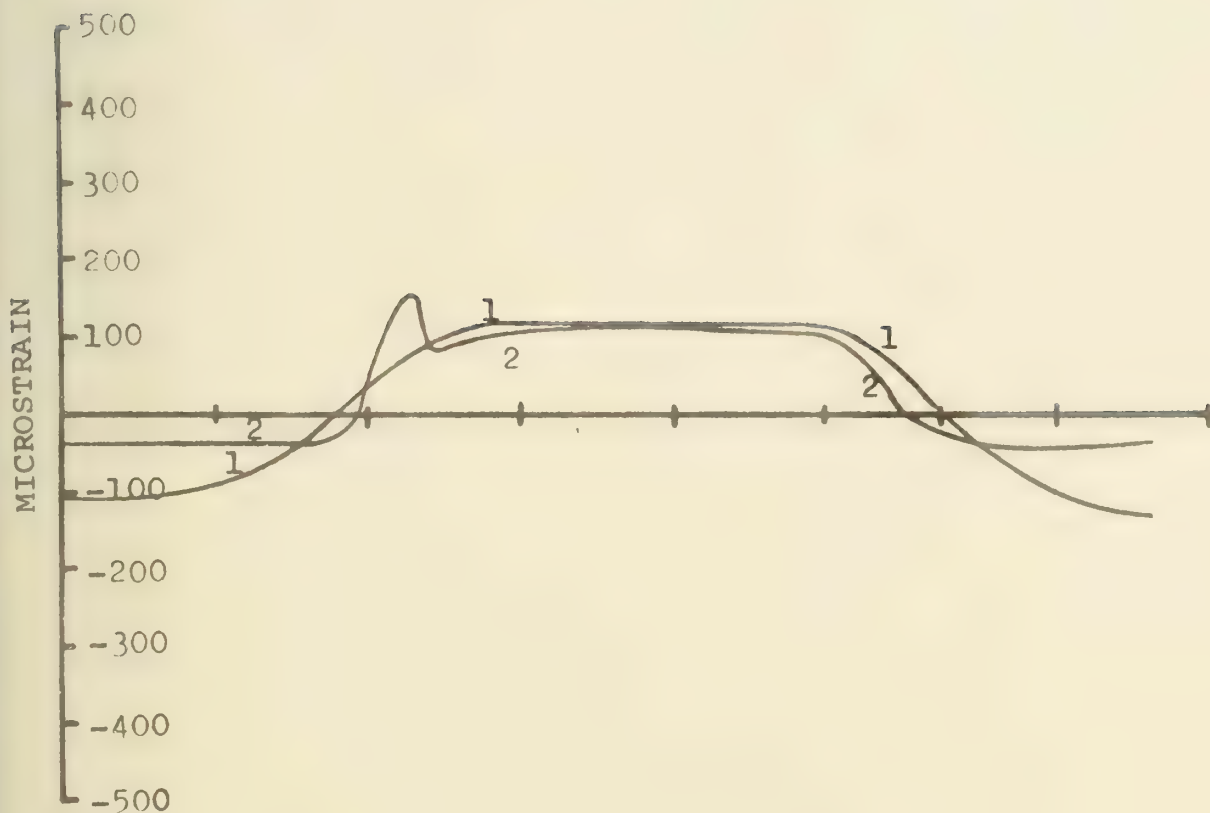
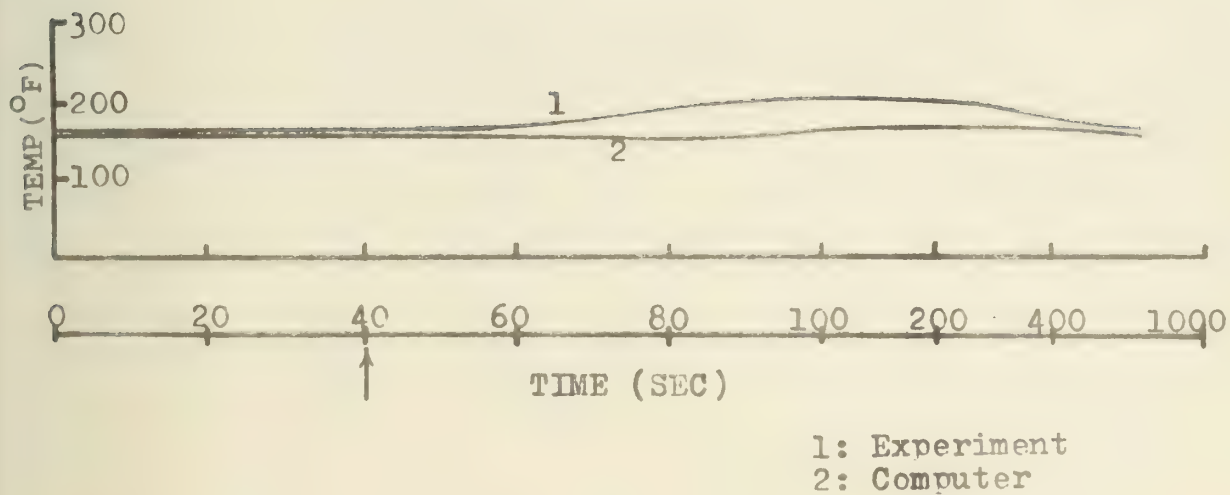


Figure 43 - HY-130 Specimen I, 4.25", Temperature and Strain Analytical Comparison, Pass 3



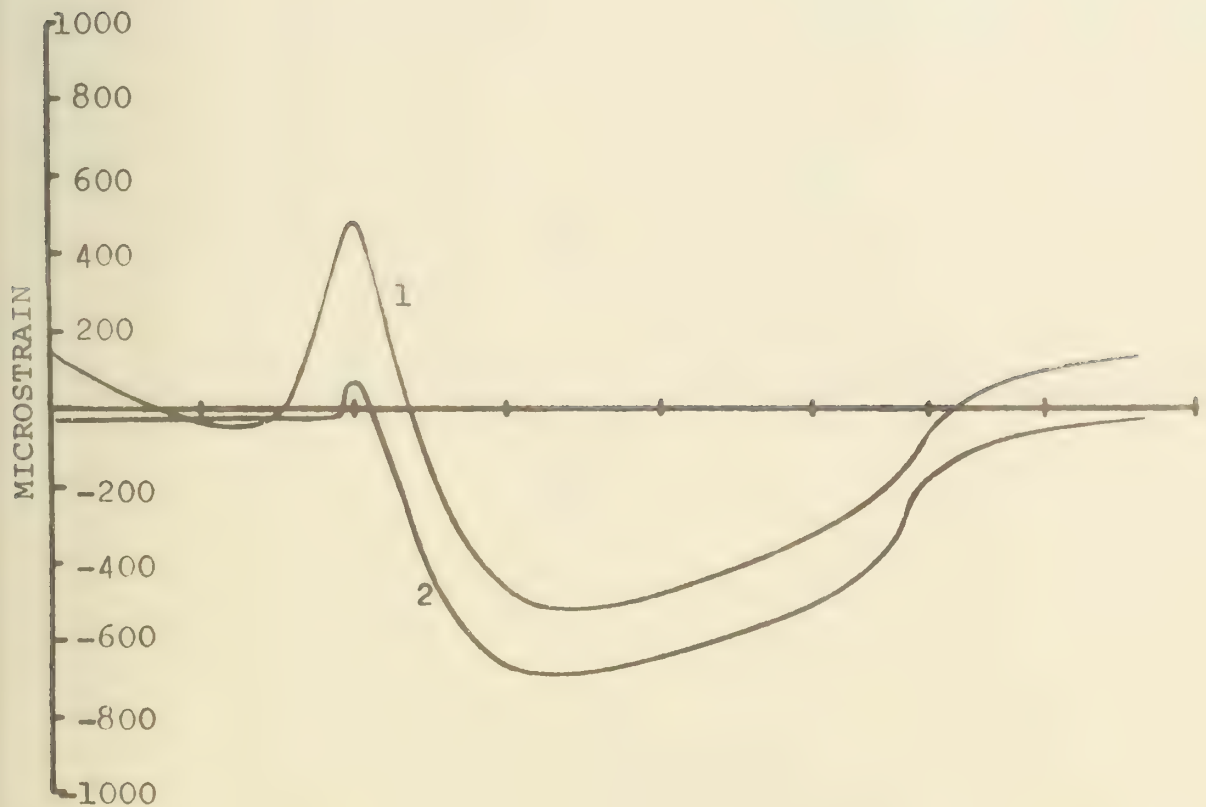
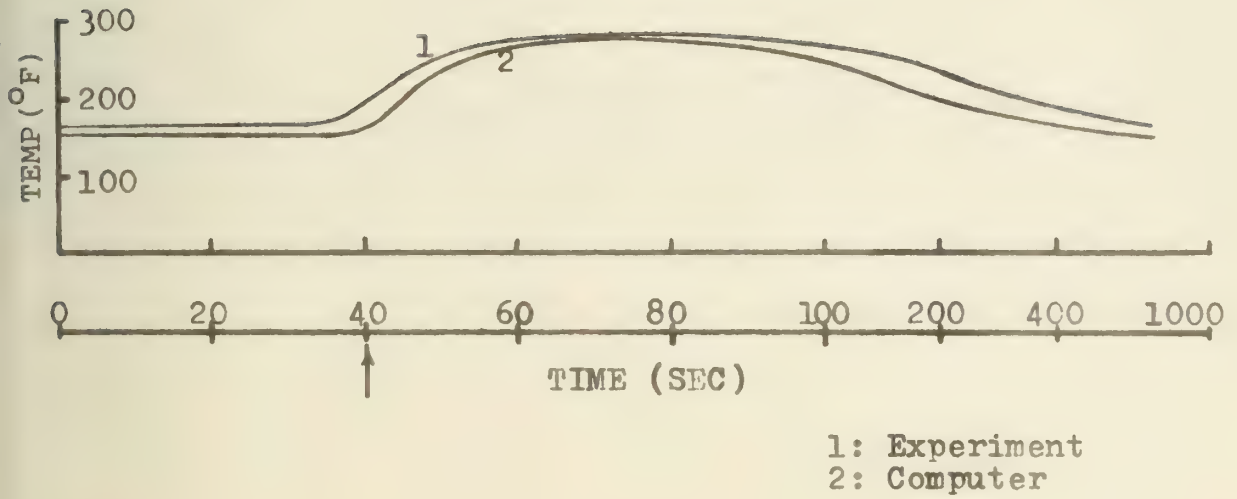
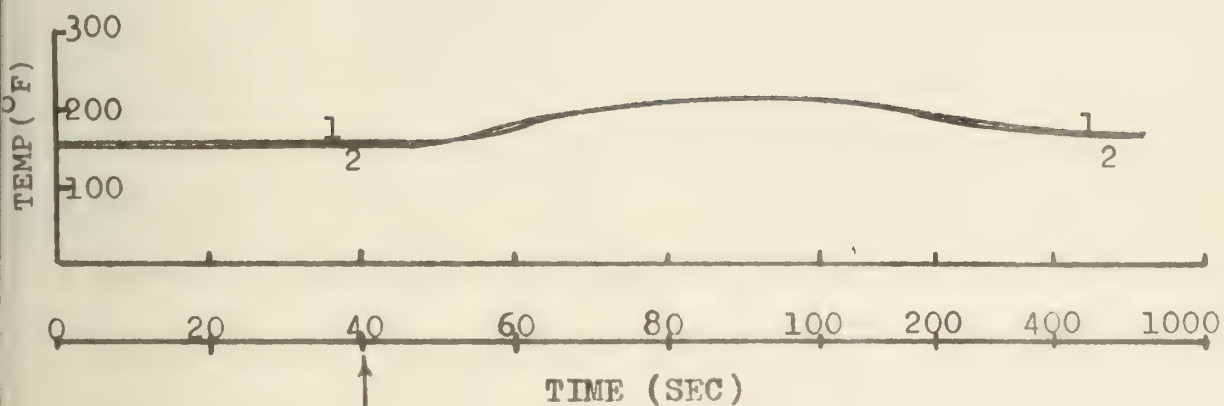


Figure 44 - 1020 Steel, 1.25", Temperature and Strain Analytical Comparison, Pass 3





1: Experiment  
2: Computer

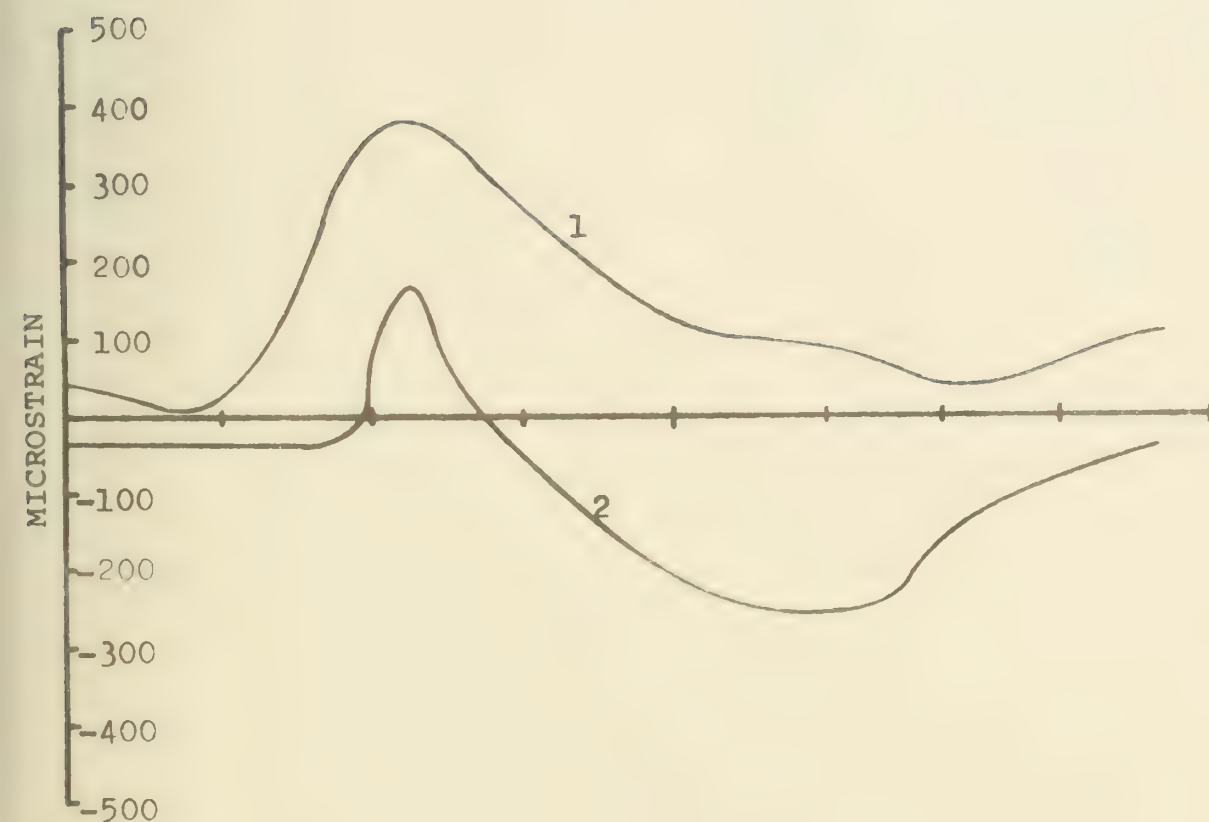


Figure 45 - 1020 Steel, 2.25", Temperature and Strain Analytical Comparison, Pass 3



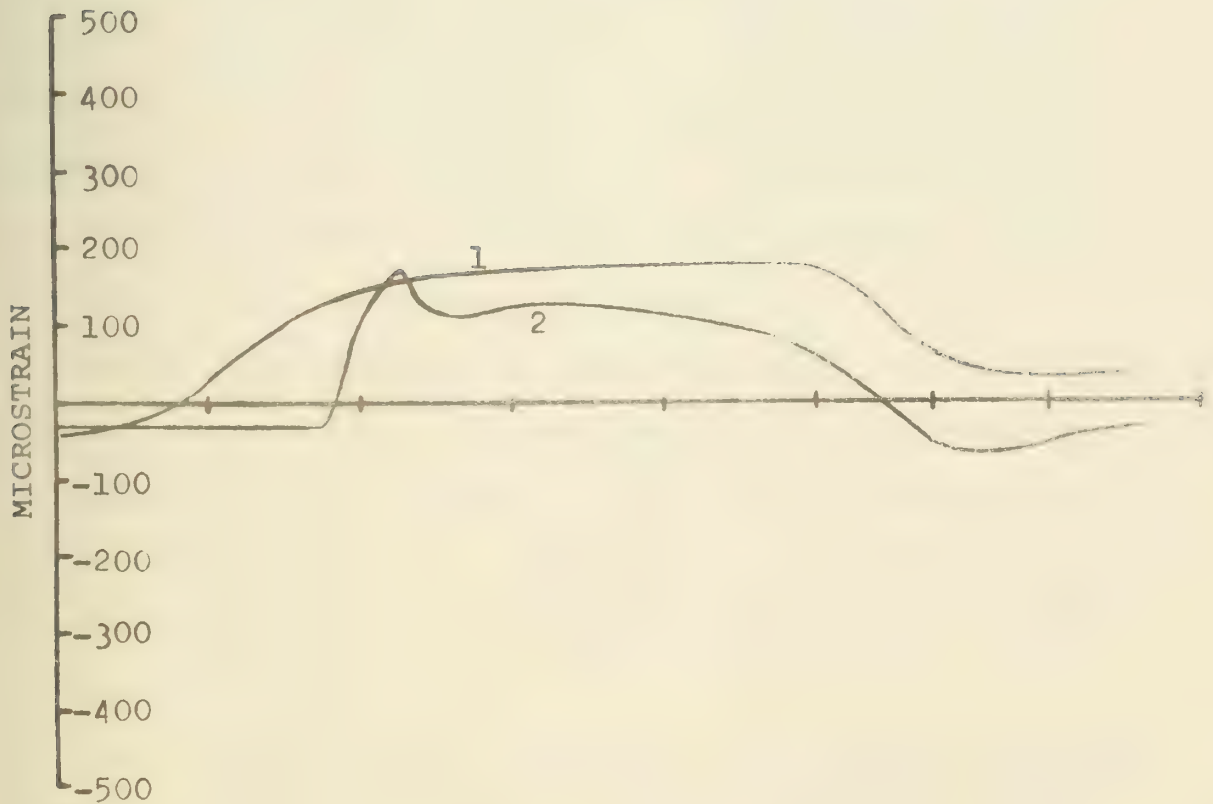
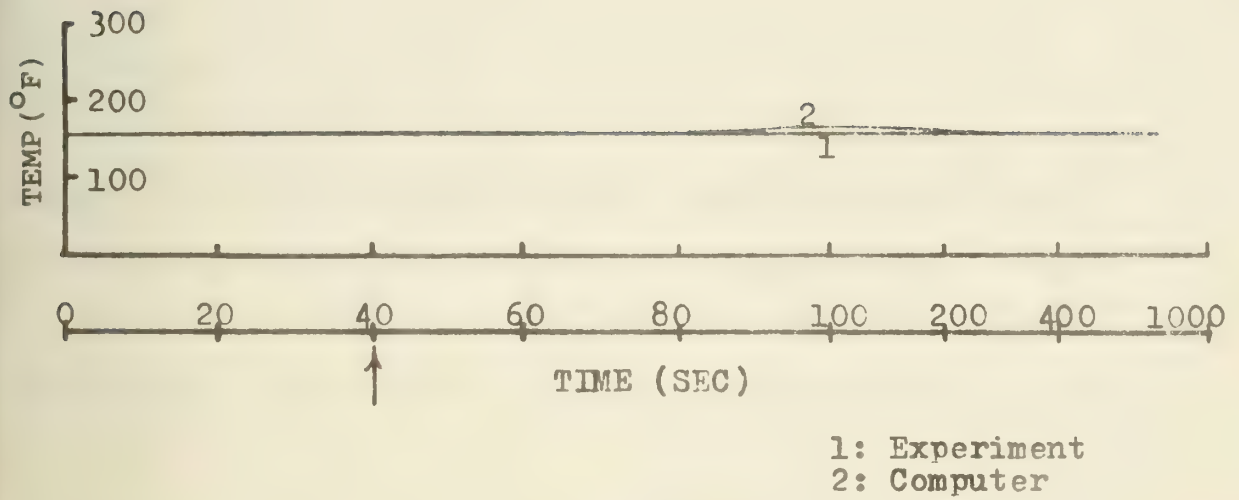


Figure 46 - 1020 Steel, 4.25", Temperature and Strain Analytical Comparison, Pass 3





## CHAPTER V

### DISCUSSION OF RESULTS

#### A. HY-130

In reviewing the results for HY-130, Specimen I shows almost identical results for each pass except for pass 2. After welding pass 1 on Specimen I, longitudinal cracks appeared along the fusion line between the bead and the base metal. They did not extend the entire length of the weld, but did exist in the vicinity of the instrumentation. This is the likely reason that the curves for pass 2 have not quite reached the characteristic shapes shown for passes 3-6. No cracks in the weld appeared following any passes except pass 1 on Specimen I. On Specimen I, where the measured strain at 1.25" from the weld line for passes 2 and 4 does not reach compressive strains as large as for passes 3, 5, and 6, it is felt that this is due to the slight movement of the arc from the prescribed weld line in order to fill the groove. As the arc was further from the points of measurement for passes 2 and 4 than for the other passes, the maximum temperature and strains reached were lower.

During the welding of Specimen II, no cracking occurred after any of the passes and the curves for strain measured at 1.0", 1.5", and 2.0" from the weld line exhibited a



characteristic shape immediately with pass 2, as shown in Figures 27 through 31. Great care was taken to fill the groove with minimal movement of the arc away from the center of the weld line. It is thought that this contributed to the relatively small variation in maximum tensile and compressive strains from one pass to the next.

Very interesting results occurred at 0.6" from the weld line on Specimen II, as shown in Figure 32. This location was the closest point of measurement to the arc and the first notable observation is that the strains which exist between passes reach very high levels of tensile strain. These strain levels are approximately four times the interpass strain levels measured at 1.0" from the weld line. The second notable aspect of the curves is the rapidity in which the strain changes from a smoothly decreasing tensile strain to a high tensile peak and then returns to a smoothly decreasing tensile strain for passes 2, 3, and 4 (not shown). This entire change takes place in less than half the time and covers a much larger total strain change than that measured at any other transverse position. Following these strain movements, pass 5 shows no tensile peak at all but rather the strain starts at a high tensile strain level, reaches a minimum, and returns to a high tensile strain level. As stated in the previous



section, data for pass 6 is unreliable due to the temperatures greatly exceeding the maximum allowable for the strain gage.

This behavior at 0.6" from the weld line resembles that reported by Klein [2] in his study on 3/4" thick HY-130 plate. He reported two tensile peaks at points 1.0" or closer to the weld line. The differences between these results and those of Klein are most likely caused by the fact that his specimens were highly restrained whereas the specimens in this study were unrestrained. Klein [2] attributes this behavior to the possibility that precipitates form in the fusion zone and weld metal upon solidification which will cause high tensile strains in the metal near the weld line. Stoop and Metzbower [16] recently reported that the microstructure in the heat affected zone of GMA weldments of HY-130 consisted of coarse grained Bainite close to the fusion zone and auto-tempered Martensite plus ferrite further away from the fusion zone. Outside the heat affected zone, the base metal remained tempered Martensite. More will be said on this later.

#### B. 1020 Steel

The results for 1020 steel closely resemble those for





HY-130 in terms of general shape of the curves of strain versus time. During welding of the first pass, there were areas of incomplete fusion and porosity. The second pass resulted in a complete, high quality bead. It is thought that the results shown for pass 2 reflect the low quality weld bead on the first pass and the results for the following passes show the characteristic strain behavior of a good weld in 1020 steel. The results measured at 6.25" from the weld line showed very little strain movement and are deleted from the figures.

### C. Analytical Comparison

Figures 38 through 46 compare experimental results for temperature and longitudinal strain with one-dimensional computer program predictions for temperature and longitudinal strain. The results for pass 3 were arbitrarily chosen as they are entirely typical of the comparisons for the other passes.

Immediately apparent upon looking at the figures is that the temperature comparisons are very good whereas the strain comparisons are not very good in most cases. In calculating the temperature, the computer program treats the temperature distribution around the moving arc as a two-dimensional heat conduction problem. It appears that





this approach is adequate to describe the temperature distribution in the plates. Of interest in the results is that the arc efficiency used for calculating the temperature distribution was the same for both HY-130 and 1020 steel. This supports the contention that arc efficiency is only a function of the welding equipment used and not a function of the material being welded.

In analyzing strains, the one-dimensional program assumes that the longitudinal strain is only a function of the transverse distance from the weld line and the transverse strain as well as the shear strain are assumed to be zero. In fact, the transverse strains measured were not zero and for distances from the weld line of up to approximately one inch, the transverse strains were of the same order of magnitude as the longitudinal strains. At transverse distances of approximately two inches, transverse strains are greatly reduced, but still significant. Only at greater transverse distances do they become relatively insignificant. It is thought that the presence of these transverse strains accounts for the poor comparisons between the experimental results and the one-dimensional program predictions because the assumptions used in calculating the longitudinal strains are not valid in these one inch thick plates. However, it can be seen that the



results for 4.25" in both the HY-130 and 1020 steels agree more closely than for points closer to the weld line. This appears to be due to the absence of any significant transverse strains this far from the weld line.

To summarize the computer results, treating the temperature distribution as a two-dimensional heat conduction problem is shown to be an adequate method to use in thick plates. However, in calculating longitudinal strains, the one-dimensional program is only accurate when there are insignificant transverse strains.



## CHAPTER VI

### CONCLUSIONS AND RECOMMENDATIONS

In summary, the results of these experiments indicate that the following conclusions can be made.

(1) The use of electric resistance strain gages is an inexpensive, accurate, and convenient method of measuring transient thermal strains which occur during welding.

(2) The strain system which exists close to the weld line in HY-130 is extremely complex and not well understood. The strain results of this study at 0.6" from the weld line of an unrestrained butt weld tend to support the existence of the secondary tensile peaks in restrained butt welds as reported by Klein [7]. This behavior is not evident at distances greater than 1.0 inch from the weld line.

(3) The MIT computer program for the one-dimensional analysis of thermal stresses and metal movement during welding, which treats the temperature distribution surrounding the arc as a two-dimensional heat flow problem, accurately predicts the temperature distribution in one inch thick HY-130 and low carbon steel plates.

(4) The existence of large transverse strains invalidates the assumptions made by the one-dimensional computer



program in calculating the longitudinal strains close to the weld line in thick plates. Therefore, the usefulness of the one-dimensional program for predicting longitudinal strains in thick plates is very limited.

(5) The description by Masubuchi [10] of the strain changes occurring in the base metal near the weld as the arc goes by is validated by the results of this study. Figure 47 shows the longitudinal strain field for HY-130 at times thirty seconds before the passage of the arc, during the passage of the arc, and ten minutes after the passage of the arc for pass 3. These curves show that just before the passage of the arc, strains are small with compressive strains near the weld becoming tensile far away. At the moment of passage, most of the plate is in tension with metal near the weld line in compression. Then, ten minutes after the passage of the arc, high tensile strains exist near the weld, changing to compressive strains at points further than approximately two inches.

The results of this study create the desire to continue the work on these specimen plates. Recommendations for further study include the following.

(1) Compare the results with the predictions of a two-dimensional analysis of thermal stresses and metal movement.





(2) Conduct a residual stress analysis of the weldment.

(3) Conduct a metallurgical characterization study of the weldment to complement the study by Stoop and Metz-bower [14].



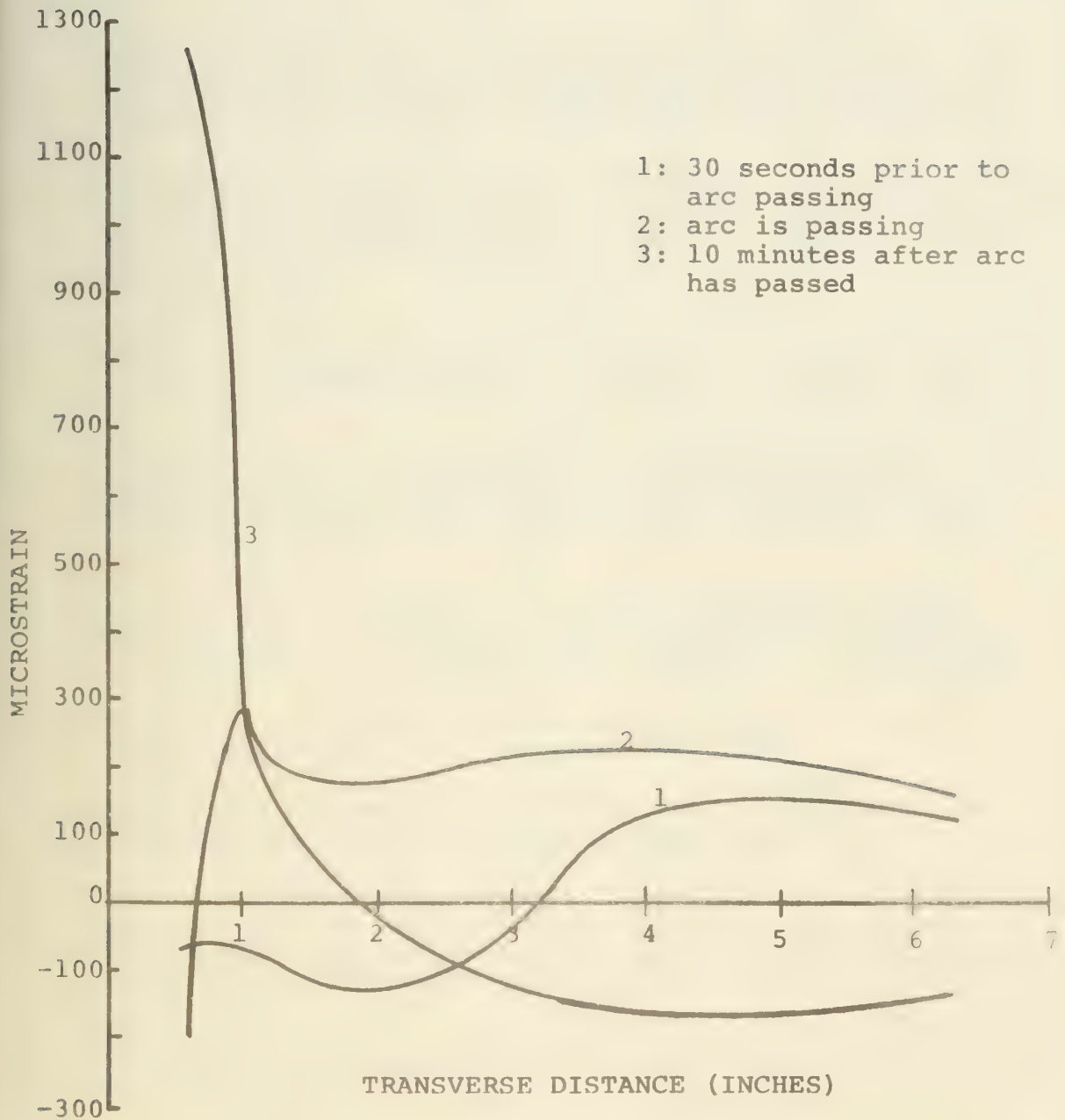


Figure 47 - Longitudinal Strain Field in HY-130, Pass 3



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## APPENDIX

Analytical Predictions for HY-130 steel are presented.



0.0 0.600 0.996 1.240 1.500 2.000 2.250 4.240 7.200 9.600 12.000

HEAT SOURCE AT T= 10.00

TIME= 0.0 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00  
MECH. STRAIN 0.0 -0.000 0.0 -0.000 0.0 -0.000 -0.000 -0.000 0.0 -0.000 0.0  
PLASTIC STRAIN 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954  
STRESS 0.0 -0.000 0.0 -0.000 0.0 -0.000 0.000 -0.000 0.000 0.0 -0.000

TIME= 1.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00  
MECH. STRAIN 0.0 -0.000 0.0 -0.000 0.0 -0.000 0.000 -0.000 0.000 0.0 -0.000  
PLASTIC STRAIN 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.754 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954  
STRESS 0.0 -0.000 0.0 -0.000 0.0 -0.000 0.000 -0.000 0.000 0.0 -0.000

TIME= 2.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00  
MECH. STRAIN 0.0 -0.000 0.0 -0.000 0.0 -0.000 0.000 -0.000 0.000 0.0 -0.000  
PLASTIC STRAIN 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954  
STRESS 0.0 -0.000 0.0 -0.000 0.0 -0.000 0.000 -0.000 0.000 0.0 -0.000

TIME= 3.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00  
MECH. STRAIN 0.0 -0.000 0.0 -0.000 0.0 -0.000 0.000 -0.000 0.000 0.0 -0.000  
PLASTIC STRAIN 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954  
STRESS 0.0 -0.000 0.0 -0.000 0.0 -0.000 0.000 -0.000 0.000 0.0 -0.000

TIME= 4.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00  
MECH. STRAIN 0.0 -0.000 0.0 -0.000 0.0 -0.000 0.000 -0.000 0.000 0.0 -0.000  
PLASTIC STRAIN 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954  
STRESS 0.0 -0.000 0.0 -0.000 0.0 -0.000 0.000 -0.000 0.000 0.0 -0.000

TIME= 5.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00 150.00  
MECH. STRAIN 0.0 -0.000 0.0 -0.000 0.0 -0.000 0.000 -0.000 0.000 0.0 -0.000  
PLASTIC STRAIN 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954  
STRESS 0.0 -0.000 0.0 -0.000 0.0 -0.000 0.000 -0.000 0.000 0.0 -0.000







TIME=	13.00	INVOLVE MULTI-PASS EFFECT 1 PASS									
TEMPERATURE	2500.00	278.28	164.30	152.93	150.37	150.01	150.00	150.00	150.00	150.00	150.00
MECH. STRAIN	-17.515	-0.765	0.042	0.113	0.126	0.119	0.114	0.077	0.022	-0.023	-0.068
PLASTIC STRAIN	-17.515	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.110	1.099	1.091	1.087	1.082	1.073	1.068	1.031	0.976	0.931	0.886
STRESS	0.0	-22.431	1.251	3.366	3.786	3.538	3.400	2.292	0.651	-0.083	-2.017
TIME=	14.00	INVOLVE MULTI-PASS EFFECT 1 PASS									
TEMPERATURE	2500.00	310.75	173.50	155.58	151.22	150.03	150.01	150.00	150.00	150.00	150.00
MECH. STRAIN	-17.469	-0.963	0.017	0.134	0.158	0.154	0.148	0.100	0.023	-0.030	-0.068
PLASTIC STRAIN	-17.469	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.150	1.142	1.132	1.126	1.120	1.108	1.102	1.054	0.982	0.924	0.866
STRESS	0.0	-28.099	0.512	3.996	4.701	4.501	4.404	2.972	0.347	-0.080	-2.604
TIME=	15.00	INVOLVE MULTI-PASS EFFECT 1 PASS									
TEMPERATURE	2500.00	344.16	184.01	159.32	152.27	150.06	150.01	150.00	150.00	150.00	150.00
MECH. STRAIN	-17.431	-1.103	0.027	0.161	0.182	0.182	0.175	0.113	0.034	-0.035	-0.104
PLASTIC STRAIN	-17.431	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.194	1.177	1.165	1.158	1.151	1.137	1.124	1.072	0.988	0.919	0.850
STRESS	0.0	-32.088	-0.732	4.167	5.410	5.428	5.223	3.527	1.009	-1.030	-3.085
TIME=	16.00	INVOLVE MULTI-PASS EFFECT 1 PASS									
TEMPERATURE	2500.00	350.35	196.31	164.05	154.77	150.13	150.03	150.00	150.00	150.00	150.00
MECH. STRAIN	-17.400	-1.197	-0.082	0.135	0.172	0.205	0.190	0.134	0.038	-0.039	-0.117
PLASTIC STRAIN	-17.400	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.225	1.205	1.192	1.184	1.176	1.160	1.152	1.087	0.992	0.915	0.837
STRESS	0.0	-34.730	-2.416	3.998	5.893	6.110	5.889	3.980	1.144	-1.163	-3.470
TIME=	17.00	INVOLVE MULTI-PASS EFFECT 1 PASS									
TEMPERATURE	2500.00	361.23	207.79	169.52	159.77	150.24	150.05	150.00	150.00	150.00	150.00
MECH. STRAIN	-17.375	-1.256	-0.140	0.118	0.204	0.224	0.231	0.146	0.042	-0.042	-0.127
PLASTIC STRAIN	-17.375	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.250	1.229	1.215	1.206	1.197	1.179	1.170	1.120	0.996	0.911	0.827
STRESS	0.0	-36.303	-4.152	3.515	6.083	6.660	6.433	4.353	1.259	-1.263	-3.782
TIME=	18.00	INVOLVE MULTI-PASS EFFECT 1 PASS									
TEMPERATURE	2500.00	366.30	216.56	175.46	158.22	150.41	150.10	150.00	150.00	150.00	150.00
MECH. STRAIN	-17.354	-1.290	-0.198	0.095	0.204	0.239	0.231	0.157	0.045	-0.045	-0.136
PLASTIC STRAIN	-17.354	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.271	1.248	1.233	1.224	1.214	1.195	1.186	1.110	0.999	0.929	0.818
STRESS	0.0	-37.534	-5.059	2.823	6.075	7.101	6.882	4.665	1.351	-1.344	-4.036
TIME=	19.00	INVOLVE MULTI-PASS EFFECT 1 PASS									
TEMPERATURE	2500.00	372.64	228.43	181.62	161.53	151.00	150.16	150.00	150.00	150.00	150.00
MECH. STRAIN	-17.336	-1.306	-0.252	0.068	0.198	0.248	0.244	0.166	0.048	-0.047	-0.143
PLASTIC STRAIN	-17.336	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.289	1.265	1.249	1.239	1.229	1.209	1.199	1.102	0.990	0.811	0.811
STRESS	0.0	-37.785	-7.447	2.004	5.883	7.368	7.259	4.932	1.435	-1.439	-4.253





TIME= 20.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 2500.00 375.02 276.88 107.79 163.23 151.47 150.26 150.00 150.00 150.00 150.00  
 MECH. STRAIN -17.222 -1.311 -0.301 0.037 0.190 0.250 0.254 0.173 0.051 -0.049 -0.149  
 PLASTIC STRAIN -17.222 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.303 1.279 1.262 1.252 1.241 1.220 1.210 1.127 1.004 0.905 0.805  
 STRESS 0.0 -37.894 -8.800 1.106 5.050 7.632 7.566 5.157 1.506 -1.462 -4.433

TIME= 30.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMP DOES NOT CONVERGE J= 1 IN, TO, IN= 1999.00 2374.29 1623.76\*\*\*\*\* USED IN \*\*\*\*\*

TEMPERATURE 1999.00 360.24 276.30 212.31 197.00 162.24 155.49 150.00 150.00 150.00 150.00  
 MECH. STRAIN -13.167 -1.406 -0.793 -0.459 -0.214 0.034 0.080 0.117 0.117 0.117 0.117  
 PLASTIC STRAIN -14.958 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.071 1.071 1.071 1.071 1.071 1.071 1.071 1.071 1.071 1.071 1.071  
 STRESS 3.700 -40.743 -23.256 -13.535 -6.327 0.997 2.372 3.436 3.487 3.487 3.487

TIME= 40.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 1604.62 335.39 282.84 248.46 218.18 176.60 165.04 150.02 150.00 150.00 150.00  
 MECH. STRAIN -10.437 -1.209 -0.817 -0.566 -0.348 0.056 0.024 0.127 0.127 0.127 0.127  
 PLASTIC STRAIN -12.563 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.040 1.040 1.040 1.040 1.040 1.040 1.040 1.040 1.040 1.040 1.040  
 STRESS 7.854 -35.151 -23.939 -16.653 -10.287 -1.600 0.700 3.770 3.773 3.773 3.773

TIME= 50.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 712.82 314.28 277.72 251.88 227.16 187.85 174.55 150.10 150.00 150.00 150.00  
 MECH. STRAIN -4.267 -1.054 -0.783 -0.594 -0.416 -0.138 -0.045 0.123 0.123 0.123 0.123  
 PLASTIC STRAIN -6.506 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.077 1.077 1.077 1.077 1.077 1.077 1.077 1.077 1.077 1.077 1.077  
 STRESS 114.489 -40.739 -22.946 -17.473 -12.266 -4.079 -1.337 3.653 3.674 3.674 3.674

TIME= 60.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 450.48 297.02 270.08 250.14 230.11 195.22 181.89 150.35 150.00 150.00 150.00  
 MECH. STRAIN -2.161 -0.926 -0.727 -0.582 -0.437 -0.190 -0.097 0.121 0.121 0.121 0.121  
 PLASTIC STRAIN -6.688 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.077 1.077 1.077 1.077 1.077 1.077 1.077 1.077 1.077 1.077 1.077  
 STRESS 129.359 -27.072 -21.341 -17.119 -12.900 -5.618 -2.864 3.584 3.659 3.659 3.659

TIME= 70.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 323.68 282.76 262.08 246.29 229.90 199.56 187.31 151.15 150.00 150.00 150.00  
 MECH. STRAIN -1.126 -0.822 -0.670 -0.555 -0.437 -0.222 -0.134 0.114 0.122 0.122 0.122  
 PLASTIC STRAIN -5.720 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075  
 STRESS 133.841 -24.075 -19.685 -16.346 -12.897 -6.559 -3.561 3.386 3.619 3.619 3.619

TIME= 80.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 250.35 270.71 254.40 241.62 228.05 201.30 190.31 152.00 150.00 150.00 150.00  
 MECH. STRAIN -0.387 -0.736 0.0 -0.617 -0.524 -0.427 -0.240 -0.159 0.135 0.119 0.119  
 PLASTIC STRAIN -5.218 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.073 1.073 1.073 1.073 1.073 1.073 1.073 1.073 1.073 1.073 1.073  
 STRESS 130.249 -21.603 -18.135 -15.438 -12.584 -7.099 -4.718 3.130 3.543 3.543 3.543



TIME= 30.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 269.26 260.53 287.26 236.74 225.37 202.61 192.24 153.01 150.00 150.00 150.00  
MECH. STRAIN -0.20 -0.664 -0.560 -0.492 -0.410 -0.249 -0.176 0.116 0.116 0.116  
PLASTIC STRAIN -4.952 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.070 1.070 1.070 1.070 1.070 1.070 1.070 1.070 1.070 1.070  
STRESS 137.674 -19.520 -16.717 -14.499 -12.112 -7.359 -5.207 2.443 3.452 3.453

TIME= 100.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 105.00 251.66 240.72 231.92 222.31 202.49 193.17 154.09 150.01 150.00 150.00  
MECH. STRAIN -0.133 -0.603 -0.524 -0.461 -0.392 -0.251 -0.106 0.085 0.113 0.113  
PLASTIC STRAIN -4.405 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.066 1.066 1.066 1.066 1.066 1.066 1.066 1.066 1.066 1.066  
STRESS 136.517 -17.741 -15.433 -13.583 -11.567 -7.431 -5.496 2.525 3.353 3.354

TIME= 150.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 151.05 220.39 215.33 211.19 206.43 195.87 190.44 158.73 150.12 150.00 150.00  
MECH. STRAIN 0.074 -0.396 -0.360 -0.331 -0.297 -0.222 -0.184 0.135 0.094 0.095  
PLASTIC STRAIN -4.805 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.048 1.048 1.048 1.048 1.048 1.048 1.048 1.048 1.048 1.048  
STRESS 145.175 -11.695 -10.646 -9.774 -8.762 -6.500 -5.463 1.035 2.790 2.820

TIME= 200.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 150.26 201.29 198.56 196.23 193.54 187.36 181.03 161.01 150.45 150.01 150.00  
MECH. STRAIN 0.076 -0.277 -0.258 -0.242 -0.223 -0.179 -0.156 0.003 0.075 0.078  
PLASTIC STRAIN -4.805 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.032 1.032 1.032 1.032 1.032 1.032 1.032 1.032 1.032 1.032  
STRESS 145.284 -8.203 -7.636 -7.154 -6.597 -5.317 -4.631 0.098 2.236 2.327

TIME= 250.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 150.09 140.55 146.91 145.49 143.42 179.44 177.80 161.36 151.11 150.05 150.00  
MECH. STRAIN 0.064 -0.202 -0.190 -0.180 -0.169 -0.142 -0.127 -0.013 0.057 0.064  
PLASTIC STRAIN -4.805 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.018 1.018 1.018 1.018 1.018 1.018 1.018 1.018 1.018 1.018  
STRESS 144.908 -5.979 -5.640 -5.347 -5.003 -4.204 -3.765 -0.398 1.686 1.910

TIME= 300.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 150.01 174.41 176.37 177.47 176.42 173.88 172.46 160.69 151.55 150.12 150.01  
MECH. STRAIN 0.052 -0.150 -0.143 -0.137 -0.129 -0.112 -0.102 -0.021 0.041 0.052  
PLASTIC STRAIN -4.805 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.076 1.076 1.076 1.076 1.076 1.076 1.076 1.076 1.076 1.076  
STRESS 144.562 -4.458 -4.244 -4.059 -3.842 -3.321 -3.031 -0.626 1.233 1.545

TIME= 350.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 150.36 172.74 172.10 171.50 170.78 169.06 166.09 154.60 151.45 150.22 150.03  
MECH. STRAIN 0.042 -0.115 -0.110 -0.106 -0.101 -0.089 -0.074 -0.024 0.029 0.042  
PLASTIC STRAIN -4.805 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.079 1.079 1.079 1.079 1.079 1.079 1.079 1.079 1.079 1.079  
STRESS 144.241 -3.400 -3.260 -3.136 -2.984 -2.638 -2.433 -0.737 0.363 1.230









TIME = 750.30

INVOLVE MULTI-PASS EFFECT 1 PASS

	150.00	153.69	153.64	153.60	153.54	153.40	153.32	152.40	151.17	150.50	150.31
TEMPERATURE											
NECH. STRAIN	0.02	-0.03	-0.02	-0.02	-0.02	-0.02	-0.02	-0.04	-0.06	-0.09	0.00
PLASTIC STRAIN	-0.05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	
STRESS	148.00	-0.67	0.06	-0.65	-0.64	-0.61	-0.60	-0.43	-0.40	-0.09	

CC-00H = 3611

REVOLVE MULTI-PASS EPPLOT 1 PASS

	150.0	152.99	154.95	152.91	152.07	152.76	152.70	152.06	151.02	150.47	150.32
TEMPERATURE											
MECH. STRAIN	0.004	-0.020	-0.020	-0.019	-0.019	-0.018	-0.018	-0.014	-0.007	-0.003	-0.002
PLASTIC STRAIN	-0.065	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.059	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054
STRESS	143.030	-0.593	0.585	-0.578	-0.569	-0.548	-0.535	-0.404	-0.194	-0.083	-0.052

TIMES = 43.33

INVOLVF MULTI-PASS EFFECI 1 PASS

	152.02	152.42	152.33	152.25	152.20	151.70	150.86	150.43	150.32
TEMPERATURE									
MECH. STRAIN	-0.001	-0.010	-0.017	-0.016	-0.016	-0.014	-0.007	-0.004	-0.003
PLASTIC STRAIN	-0.699	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.698	0.693	0.693	0.693	0.694	0.693	0.693	0.693	0.693
STRESS	139,829	-0.521	-0.509	-0.503	-0.487	-0.477	-0.476	-0.470	-0.460

rr. 00f = 3M1J.

INVOLVE MULTI-PASS EFFECT 1 PASS

	150.00	151.96	151.94	151.92	151.89	151.83	151.80	151.41	150.70	150.48	150.31
TEMPERATURE											
MECH. STRAIN	-0.002	-0.016	-0.016	-0.015	-0.015	-0.015	-0.012	-0.007	-0.006	-0.004	
PLASTIC STRAIN	-0.699	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	-0.701	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	
STRESS	139.791	-0.466	-0.462	-0.458	-0.452	-0.443	-0.435	-0.421	-0.406	-0.392	

00.056 = 341.1

INVOLVE MULTI-PASS EFFECT 1 PASS

	150.00	151.60	151.50	151.56	151.54	151.50	151.47	151.17	150.65	150.44	150.30
TEMPERATURE											
MESH. STRAIN	-0.003	-0.014	-0.014	-0.014	-0.014	-0.014	-0.013	-0.011	-0.008	-0.006	-0.006
PLASTIC STRAIN	-0.009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	-0.009	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
STRESS	139.757	-0.427	-0.423	-0.420	-0.416	-0.406	-0.401	-0.340	-0.36	-0.193	-0.165

TIME = 1055.33

INVOLVE MULTI-PASS EFFECT 1 PASS

	150.00	151.30	151.28	151.27	151.26	151.22	151.20	150.97	150.56	150.41	150.29
TEMPERATURE											
MPCi. STRAIN	-0.004	-0.013	-0.013	-0.013	-0.013	-0.013	-0.013	-0.011	-0.008	-0.007	-0.006
PLASTIC STRAIN	-0.699	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.949	0.949	0.949	0.949	0.949	0.949	0.949	0.949	0.949	0.949	0.949
STRESS	139.727	-0.496	0.393	-0.390	-0.387	-0.380	-0.375	-0.328	-0.246	-0.215	-0.191

TIME = 1000.00

INV. IN CULT-PASS EFFECT 1 PASJ

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TIME=	7.00	INVOLVE MULTI-PASS EFFECT 2 PASS															
TEMPERATURE	151.66	151.32	151.29	151.27	151.26	151.22	151.20	150.97	150.56	150.41	150.29						
HECH. STRAIN	-0.025	-0.023	-0.023	-0.023	-0.023	-0.022	-0.022	-0.021	-0.016	-0.017	-0.016						
PLASTIC STRAIN	-4.699	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
TOTAL STRAIN	6.940	6.940	6.940	6.940	6.940	6.940	6.940	6.940	6.940	6.940	6.940						
STRESS	139.383	-0.665	-0.677	-0.675	-0.672	-0.664	-0.660	-0.612	-0.533	-0.499	-0.475						
TIME=	8.00	INVOLVE MULTI-PASS EFFECT 2 PASS															
TEMPERATURE	179.50	151.56	151.30	151.28	151.26	151.22	151.20	150.97	150.56	150.41	150.29						
HECH. STRAIN	-0.216	-0.024	-0.022	-0.022	-0.022	-0.021	-0.021	-0.020	-0.017	-0.016	-0.015						
PLASTIC STRAIN	-4.699	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
TOTAL STRAIN	0.941	0.941	0.941	0.941	0.941	0.941	0.941	0.941	0.941	0.941	0.941						
STRESS	134.008	-0.706	-0.654	-0.648	-0.645	-0.637	-0.633	-0.585	-0.503	-0.472	-0.448						
TIME=	9.00	INVOLVE MULTI-PASS EFFECT 2 PASS															
TEMPERATURE	60.46	154.46	151.40	151.29	151.26	151.22	151.20	150.97	150.56	150.41	150.29						
HECH. STRAIN	-1.449	-0.029	-0.006	-0.007	-0.007	-0.007	-0.007	-0.007	-0.002	-0.001	-0.001						
PLASTIC STRAIN	-4.699	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
TOTAL STRAIN	0.955	0.955	0.955	0.955	0.955	0.955	0.955	0.955	0.955	0.955	0.955						
STRESS	34.599	-0.864	-0.244	-0.222	-0.216	-0.208	-0.203	-0.156	-0.073	-0.043	-0.019						
TIME=	10.00	INVOLVE MULTI-PASS EFFECT 2 PASS															
TEMPERATURE	2500.00	160.49	154.14	151.35	151.27	151.22	151.20	150.97	150.56	150.41	150.29						
HECH. STRAIN	-17.507	-0.028	0.070	0.075	0.076	0.076	0.076	0.076	0.001	0.002	0.003						
PLASTIC STRAIN	-17.507	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
TOTAL STRAIN	1.038	1.038	1.030	1.038	1.038	1.038	1.038	1.038	1.038	1.038	1.038						
STRESS	0.0	-0.841	2.083	2.242	2.259	2.269	2.273	2.321	2.403	2.434	2.458						
TIME=	11.00	INVOLVE MULTI-PASS EFFECT 2 PASS															
TEMPERATURE	2500.00	190.29	154.07	151.57	151.31	151.22	151.20	150.97	150.56	150.41	150.29						
HECH. STRAIN	-17.576	-0.225	0.067	0.084	0.086	0.087	0.087	0.080	0.091	0.092	0.093						
PLASTIC STRAIN	-17.576	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
TOTAL STRAIN	1.049	1.049	1.049	1.049	1.049	1.049	1.049	1.049	1.049	1.049	1.049						
STRESS	0.0	-6.672	1.996	2.505	2.559	2.575	2.500	2.627	2.710	2.741	2.765						
TIME=	12.00	INVOLVE MULTI-PASS EFFECT 2 PASS															
TEMPERATURE	2500.00	238.78	158.28	152.58	151.40	151.23	151.20	150.97	150.56	150.41	150.29						
HECH. STRAIN	-17.561	-0.512	0.054	0.093	0.101	0.102	0.102	0.104	0.106	0.107	0.108						
PLASTIC STRAIN	-17.561	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
TOTAL STRAIN	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064	1.064						
STRESS	0.0	-15.098	1.599	2.758	2.997	3.033	3.038	3.085	3.168	3.199	3.223						
TIME=	13.00	INVOLVE MULTI-PASS EFFECT 2 PASS															
TEMPERATURE	2500.00	279.52	165.29	154.20	151.62	151.23	151.20	150.97	150.56	150.41	150.29						
HECH. STRAIN	-17.545	-0.793	0.021	0.097	0.115	0.118	0.118	0.119	0.122	0.123	0.124						
PLASTIC STRAIN	-17.545	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0						
TOTAL STRAIN	1.080	1.080	1.080	1.080	1.080	1.080	1.080	1.080	1.080	1.080	1.080						
STRESS	0.0	-23.256	0.637	2.897	3.421	3.503	3.507	3.554	3.637	3.668	3.692						



TIME= 14.00	INVOLVE MULTI-PASS EFFECT 2 PASS										
TEMPERATURE	2500.00	311.97	174.79	156.86	152.44	151.23	151.20	150.97	150.56	150.41	150.29
MECH. STRAIN	-1.531	-1.020	-0.030	0.093	0.123	0.131	0.132	0.133	0.130	0.137	0.133
PLASTIC STRAIN	-17.531	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.094	1.094	1.094	1.094	1.094	1.094	1.094	1.094	1.094	1.094	1.094
STRESS	0.0	-29.763	-0.898	2.771	3.061	3.911	3.920	3.969	4.052	4.002	4.100
TIME= 15.00	INVOLVE MULTI-PASS EFFECT 2 PASS										
TEMPERATURE	2500.00	345.36	105.89	160.60	153.53	151.29	151.21	150.97	150.56	150.41	150.29
MECH. STRAIN	-17.520	-1.188	-0.096	0.079	0.127	0.143	0.143	0.145	0.148	0.149	0.143
PLASTIC STRAIN	-17.520	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.105	1.105	1.105	1.105	1.105	1.105	1.105	1.105	1.105	1.105	1.105
STRESS	0.0	-38.430	-2.847	2.348	3.709	4.244	4.259	4.309	4.392	4.422	4.446
TIME= 16.00	INVOLVE MULTI-PASS EFFECT 2 PASS										
TEMPERATURE	2500.00	351.55	197.59	165.32	155.03	151.35	151.23	150.97	150.56	150.41	150.29
MECH. STRAIN	-17.511	-1.297	-0.169	0.056	0.126	0.152	0.152	0.154	0.157	0.158	0.153
PLASTIC STRAIN	-17.511	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114	1.114
STRESS	0.0	-37.013	-4.991	1.601	3.761	4.513	4.535	4.588	4.671	4.731	4.726
TIME= 17.00	INVOLVE MULTI-PASS EFFECT 2 PASS										
TEMPERATURE	2500.00	362.42	209.07	170.74	157.03	151.40	151.25	150.97	150.56	150.41	150.29
MECH. STRAIN	-17.503	-1.371	-0.242	0.026	0.121	0.159	0.160	0.162	0.165	0.161	0.167
PLASTIC STRAIN	-17.503	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.122	1.122	1.122	1.122	1.122	1.122	1.122	1.122	1.122	1.122	1.122
STRESS	0.0	-39.720	-7.152	0.771	3.586	4.719	4.761	4.819	4.902	4.932	4.957
TIME= 18.00	INVOLVE MULTI-PASS EFFECT 2 PASS										
TEMPERATURE	2500.00	369.49	219.03	176.74	159.46	151.63	151.30	150.97	150.56	150.41	150.29
MECH. STRAIN	-17.496	-1.418	-0.312	-0.009	0.110	0.164	0.166	0.168	0.171	0.172	0.173
PLASTIC STRAIN	-17.496	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.129	1.129	1.129	1.129	1.129	1.129	1.129	1.129	1.129	1.129	1.129
STRESS	0.0	-41.042	-9.268	-0.250	3.279	4.878	4.946	5.013	5.096	5.126	5.151
TIME= 19.00	INVOLVE MULTI-PASS EFFECT 2 PASS										
TEMPERATURE	2500.00	373.83	229.60	182.89	162.33	152.22	151.36	150.97	150.56	150.41	150.29
MECH. STRAIN	-17.491	-1.446	-0.376	-0.046	0.096	0.166	0.171	0.174	0.177	0.178	0.173
PLASTIC STRAIN	-17.491	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.134	1.134	1.134	1.134	1.134	1.134	1.134	1.134	1.134	1.134	1.134
STRESS	0.0	-41.808	-11.092	-1.359	2.865	4.925	5.100	5.180	5.263	5.294	5.313
TIME= 20.00	INVOLVE MULTI-PASS EFFECT 2 PASS										
TEMPERATURE	2397.22	376.21	238.11	199.06	165.49	152.70	151.46	150.97	150.56	150.41	150.29
MECH. STRAIN	-16.682	-1.546	-0.519	-0.171	-0.067	0.000	0.089	0.092	0.095	0.096	0.093
PLASTIC STRAIN	-17.491	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.053	1.053	1.053	1.053	1.053	1.053	1.053	1.053	1.053	1.053	1.053
STRESS	0.332	-44.662	-15.300	-5.058	-0.213	2.595	2.645	2.745	2.828	2.859	2.883





TIME= 30.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 1491.70 361.46 279.53 233.56 199.06 163.46 156.89 150.97 150.56 150.41 150.29  
MECH. STRAIN -10.501 -1.412 -0.799 -0.465 -0.213 0.328 0.075 0.114 0.117 0.118 0.114  
PLASTIC STRAIN -13.219 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.074 1.074 1.074 1.074 1.074 1.074 1.074 1.074 1.074 1.074 1.074  
STRESS 16.031 -40.908 -23.424 -13.702 -6.491 0.643 2.223 3.387 3.470 3.500 3.525

TIME= 40.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 1034.51 336.63 284.08 249.70 219.42 177.62 166.29 150.98 150.56 150.41 150.29  
MECH. STRAIN -7.257 -1.223 -0.832 -0.580 -0.363 -0.370 0.010 0.115 0.117 0.118 0.113  
PLASTIC STRAIN -11.094 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075  
STRESS 82.465 -35.577 -24.365 -17.078 -10.711 -2.376 0.289 3.409 3.495 3.525 3.550

TIME= 50.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 789.74 315.52 278.96 253.12 228.39 189.07 175.75 151.07 150.56 150.41 150.29  
MECH. STRAIN -4.595 -1.065 -0.794 -0.605 -0.427 -0.140 -0.056 0.114 0.117 0.118 0.119  
PLASTIC STRAIN -8.845 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075  
STRESS 111.644 -31.069 -22.277 -17.001 -12.592 -4.396 -1.650 3.391 3.495 3.525 3.549

TIME= 60.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 579.54 293.28 271.33 251.38 231.34 196.43 183.09 151.32 150.56 150.41 150.29  
MECH. STRAIN -3.139 -0.938 -0.739 -0.594 -0.449 -0.201 -0.108 0.111 0.116 0.117 0.114  
PLASTIC STRAIN -7.564 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.074 1.074 1.074 1.074 1.074 1.074 1.074 1.074 1.074 1.074 1.074  
STRESS 123.127 -27.421 -21.688 -17.464 -13.243 -5.953 -3.194 3.309 3.403 3.493 3.518

TIME= 70.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 465.75 284.02 263.33 247.53 231.14 200.77 188.21 152.11 150.56 150.41 150.29  
MECH. STRAIN -2.224 -0.834 -0.682 -0.568 -0.449 -0.233 -0.145 0.104 0.115 0.116 0.114  
PLASTIC STRAIN -6.745 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.072 1.072 1.072 1.072 1.072 1.072 1.072 1.072 1.072 1.072 1.072  
STRESS 128.719 -24.439 -20.046 -16.765 -13.253 -6.907 -4.304 3.094 3.409 3.440 3.464

TIME= 80.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 384.12 272.04 255.66 242.87 229.29 203.01 191.51 152.97 150.56 150.41 150.29  
MECH. STRAIN -1.569 -0.749 -0.629 -0.537 -0.439 -0.252 -0.171 0.095 0.112 0.113 0.114  
PLASTIC STRAIN -6.160 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.069 1.069 1.069 1.069 1.069 1.069 1.069 1.069 1.069 1.069 1.069  
STRESS 131.977 -21.974 -18.504 -15.804 -12.948 -7.455 -5.069 2.837 3.325 3.356 3.380

TIME= 90.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 324.34 261.79 248.52 237.59 226.61 203.82 193.43 153.97 150.56 150.41 150.29  
MECH. STRAIN -1.140 -0.677 -0.581 -0.505 -0.423 -0.261 -0.168 0.045 0.109 0.110 0.110  
PLASTIC STRAIN -2.744 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.066 1.066 1.066 1.066 1.066 1.066 1.066 1.066 1.066 1.066 1.066  
STRESS 133.012 -19.896 -17.090 -14.871 -12.440 -7.720 -5.363 2.537 3.236 3.261 3.285





TIME= 100.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 200.04 252.93 241.98 233.17 223.55 203.70 194.37 155.05 150.56 150.41 150.29  
 MECH. STRAIN -0.820 -0.616 -0.507 -0.473 -0.405 -0.263 0.0 0.0 0.105 0.106 0.117  
 PLASTIC STRAIN -5.835 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.003 1.003 1.003 1.003 1.003 1.003 1.003 1.003 1.003 1.003 1.003  
 STRESS 130.221 -18.122 -15.812 -13.459 -11.940 -7.796 -5.856 2.215 3.126 3.158 3.162

TIME= 150.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 183.82 221.67 216.65 212.45 207.66 197.00 191.63 159.75 150.68 150.41 150.29  
 MECH. STRAIN -0.142 -0.409 -0.373 -0.343 -0.310 -0.235 -0.197 0.024 0.086 0.088 0.049  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.045 1.045 1.045 1.045 1.045 1.045 1.045 1.045 1.045 1.045 1.045  
 STRESS 148.591 -12.076 -11.027 -10.150 -9.154 -6.923 -5.824 3.725 2.570 2.624 2.648

TIME= 200.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 159.41 202.58 199.63 197.50 194.80 184.37 185.23 161.94 151.31 153.42 150.29  
 MECH. STRAIN 0.009 -0.291 -0.271 -0.255 -0.236 -0.192 -0.169 -0.060 0.007 0.071 0.072  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027  
 STRESS 143.865 -8.606 -8.036 -7.552 -6.951 -5.703 -5.013 -0.244 1.987 2.107 2.133

TIME= 250.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 152.72 189.04 186.18 186.76 185.36 181.16 179.00 162.32 151.66 150.40 150.29  
 MECH. STRAIN 0.941 -0.216 -0.204 -0.194 -0.182 -0.155 -0.140 -0.025 0.048 0.050 0.057  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.013 1.013 1.013 1.013 1.013 1.013 1.013 1.013 1.013 1.013 1.013  
 STRESS 144.503 -6.386 -6.043 -5.749 -5.404 -4.597 -4.151 -0.736 1.432 1.677 1.710

TIME= 300.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 150.81 180.71 179.66 178.74 177.68 175.19 173.66 161.66 152.11 150.53 150.30  
 MECH. STRAIN 0.942 -0.164 -0.157 -0.150 -0.143 -0.125 -0.115 -0.032 0.033 0.044 0.045  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.001 1.001 1.001 1.001 1.001 1.001 1.001 1.001 1.001 1.001 1.001  
 STRESS 144.556 -4.868 -4.650 -4.461 -4.243 -3.716 -3.418 -0.965 0.977 1.298 1.344

TIME= 350.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 150.24 174.08 173.38 172.77 172.03 170.28 169.23 160.57 152.40 150.62 150.32  
 MECH. STRAIN 0.935 -0.128 -0.123 -0.119 -0.114 -0.102 -0.095 -0.035 0.021 0.033 0.035  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.991 0.991 0.991 0.991 0.991 0.991 0.991 0.991 0.991 0.991 0.991  
 STRESS 144.375 -3.807 -3.664 -3.538 -3.388 -3.023 -2.826 -1.046 0.614 0.975 1.037

TIME= 400.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE 150.20 169.12 168.60 168.21 167.70 166.00 165.17 159.15 162.55 150.20 150.35  
 MECH. STRAIN 0.927 -0.102 -0.099 -0.096 -0.093 -0.084 -0.074 -0.035 0.011 0.024 0.026  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.982 0.982 0.982 0.982 0.982 0.982 0.982 0.982 0.982 0.982 0.982  
 STRESS 144.111 -3.044 -2.945 -2.850 -2.753 -2.400 -2.300 -1.051 0.332 0.702 0.777



TIME= 450.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE  
 150.07 165.34 164.99 164.69 164.33 163.45 162.95 158.16 152.57 150.61 150.39  
 MECH. STRAIN 0.021 -0.084 -0.061 -0.079 -0.077 -0.071 -0.067 -0.034 0.004 0.016 0.019  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.975 0.975 0.975 0.975 0.975 0.975 0.975 0.975 0.975 0.975 0.975  
 STRESS 143.948 -2.483 -2.412 -2.351 -2.277 -2.097 -1.994 -1.020 0.116 0.472 0.557

TIME= 500.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE  
 150.03 162.43 162.10 161.96 161.70 161.05 160.68 157.07 152.50 150.61 150.44  
 MECH. STRAIN 0.015 -0.069 -0.060 -0.066 -0.064 0.0 0.0 -0.057 -0.033 -0.002 0.012  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.969 0.969 0.969 0.969 0.969 0.969 0.969 0.969 0.969 0.969 0.969  
 STRESS 143.702 -2.004 -2.014 -1.969 -1.915 -1.704 -1.708 -0.974 -0.040 0.201 0.372

TIME= 550.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE  
 150.01 160.16 159.90 159.82 159.62 159.14 158.86 156.11 152.18 150.45 150.48  
 MECH. STRAIN 0.011 -0.059 -0.056 -0.056 -0.055 -0.052 -0.050 -0.031 -0.006 0.034 0.107  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.964 0.964 0.964 0.964 0.964 0.964 0.964 0.964 0.964 0.964 0.964  
 STRESS 143.639 -1.749 -1.712 -1.678 -1.639 -1.541 -1.484 -0.924 -0.167 0.122 0.217

TIME= 600.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE  
 150.00 158.39 158.13 157.96 157.61 157.40 155.27 152.22 150.99 150.62  
 MECH. STRAIN 0.006 -0.051 -0.050 -0.049 -0.046 0.0 0.0 -0.044 -0.030 -0.030 0.033  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.960 0.960 0.960 0.960 0.960 0.960 0.960 0.960 0.960 0.960 0.960  
 STRESS 143.510 -1.511 -1.482 -1.457 -1.427 -1.351 -1.310 -0.878 -0.236 -0.034 0.085

TIME= 650.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE  
 150.00 156.99 156.88 156.79 156.67 156.49 154.56 152.05 150.40 150.56  
 MECH. STRAIN 0.003 -0.045 -0.044 -0.043 -0.041 -0.041 -0.028 -0.011 -0.004 -0.004  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.957 0.957 0.957 0.957 0.957 0.957 0.957 0.957 0.957 0.957  
 STRESS 143.415 -1.328 -1.307 -1.288 -1.265 -1.208 -1.175 -0.835 -0.327 -0.105 -0.024

TIME= 700.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE  
 150.00 155.86 155.75 155.72 155.63 155.41 153.26 151.89 150.94 150.58  
 MECH. STRAIN 0.000 -0.040 -0.039 -0.039 -0.037 -0.037 -0.027 -0.013 -0.006 -0.004  
 PLASTIC STRAIN -4.816 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954  
 STRESS 143.330 -1.188 -1.172 -1.157 -1.139 -1.094 -1.066 -0.798 -0.379 -0.187 -0.115

TIME= 750.00 INVOLVE MULTI-PASS EFFECT 2 PASS

TEMPERATURE  
 150.00 154.99 154.93 154.87 154.80 154.62 152.45 151.70 150.1 150.60  
 MECH. STRAIN -0.004 -0.036 -0.035 -0.035 -0.035 -0.033 -0.025 -0.014 -0.006 -0.006  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.952 0.952 0.952 0.952 0.952 0.952 0.952 0.952 0.952 0.952  
 STRESS 143.024 -1.066 -1.053 -1.041 -1.027 -0.991 -0.773 -0.404 -0.139 -0.118



TIME= 800.00	INVOLVE MULTI-PASS EFFECT 2 PASS											
TEMPERATURE	150.00	154.24	154.23	154.19	154.13	153.94	153.90	153.82	151.28	150.62	150.61	
MECH. STRAIN	-0.304	-0.033	-0.033	-0.032	-0.032	-0.031	-0.030	-0.024	-0.014	-0.010	-0.008	
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	0.950	
STRESS	139.772	-0.980	-0.970	-0.960	-0.948	-0.920	-0.933	-0.725	-0.431	-0.290	-0.235	
TIME= 950.00	INVOLVE MULTI-PASS EFFECT 2 PASS											
TEMPERATURE	150.00	153.72	153.67	153.64	153.59	153.47	153.40	152.67	151.44	150.84	150.61	
MECH. STRAIN	-0.305	-0.031	-0.030	-0.030	-0.030	-0.029	-0.029	-0.024	-0.015	-0.011	-0.010	
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.948	0.948	0.948	0.948	0.948	0.948	0.948	0.943	0.948	0.948	0.949	
STRESS	139.721	-0.915	-0.907	-0.899	-0.889	-0.865	-0.851	-0.703	-0.453	-0.312	-0.285	
TIME= 100.00	INVOLVE MULTI-PASS EFFECT 2 PASS											
TEMPERATURE	150.00	153.26	153.23	153.19	153.15	153.06	153.00	152.38	151.12	150.49	150.60	
MECH. STRAIN	-0.307	-0.029	-0.029	-0.028	-0.028	-0.028	-0.027	-0.023	-0.010	-0.013	-0.011	
PLASTIC STRAIN	-0.703	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	0.947	
STRESS	139.683	-0.861	-0.854	-0.847	-0.839	-0.819	-0.807	-0.682	-0.407	-0.380	-0.322	
TIME= 950.00	INVOLVE MULTI-PASS EFFECT 2 PASS											
TEMPERATURE	150.00	152.89	152.86	152.84	152.80	152.72	152.67	152.13	151.21	150.45	150.54	
MECH. STRAIN	-0.300	-0.028	-0.027	-0.027	-0.027	-0.026	-0.026	-0.022	-0.010	-0.014	-0.012	
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	
STRESS	139.640	-0.821	-0.815	-0.809	-0.803	-0.785	-0.775	-0.667	-0.400	-0.407	-0.355	
TIME= 1000.00	INVOLVE MULTI-PASS EFFECT 2 PASS											
TEMPERATURE	150.00	152.60	152.57	152.55	152.52	152.44	152.40	151.93	151.12	150.42	150.50	
MECH. STRAIN	-0.309	-0.027	-0.026	-0.026	-0.026	-0.026	-0.025	-0.022	-0.016	-0.014	-0.013	
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	0.945	
STRESS	139.619	-0.790	-0.785	-0.780	-0.774	-0.759	-0.750	-0.656	-0.400	-0.429	-0.381	
TIME= 0.0	INVOLVE MULTI-PASS EFFECT 3 PASS											
TEMPERATURE	150.00	152.00	152.57	152.55	152.52	152.44	152.40	151.93	151.12	150.42	150.50	
MECH. STRAIN	-0.300	-0.037	-0.037	-0.037	-0.037	-0.036	-0.036	-0.032	-0.016	-0.014	-0.014	
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	0.944	
STRESS	139.600	-1.110	-1.104	-1.099	-1.093	-1.070	-1.064	-0.975	-0.603	-0.744	-0.700	





TIME= 1.00 INVOLVE MULTI-PASS EFFECT 1 PASS

TEMPERATURE 150.00 152.60 152.57 152.55 152.52 152.44 151.93 151.12 150.82 150.58  
 MECH. STRAIN -0.020 -0.037 -0.037 -0.037 -0.036 -0.036 -0.033 -0.027 -0.025 -0.024  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934  
 STRESS 139.300 -1.110 -1.104 -1.099 -1.093 -1.078 -1.069 -0.809 -0.749 -0.700

TIME= 2.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.00 152.60 152.57 152.55 152.52 152.44 151.93 151.12 150.82 150.58  
 MECH. STRAIN -0.020 -0.037 -0.037 -0.037 -0.037 -0.036 -0.033 -0.027 -0.025 -0.024  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934  
 STRESS 139.300 -1.110 -1.104 -1.099 -1.093 -1.078 -1.069 -0.809 -0.749 -0.700

TIME= 3.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.00 152.60 152.57 152.55 152.52 152.44 151.93 151.12 150.82 150.58  
 MECH. STRAIN -0.020 -0.037 -0.037 -0.037 -0.036 -0.036 -0.033 -0.027 -0.025 -0.024  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934  
 STRESS 139.300 -1.110 -1.104 -1.099 -1.093 -1.078 -1.069 -0.809 -0.749 -0.700

TIME= 4.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.00 152.60 152.57 152.55 152.52 152.44 151.93 151.12 150.82 150.58  
 MECH. STRAIN -0.020 -0.037 -0.037 -0.037 -0.036 -0.036 -0.033 -0.027 -0.025 -0.024  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934  
 STRESS 139.300 -1.110 -1.104 -1.099 -1.093 -1.078 -1.069 -0.809 -0.749 -0.700

TIME= 5.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.00 152.60 152.57 152.55 152.52 152.44 151.93 151.12 150.82 150.58  
 MECH. STRAIN -0.020 -0.037 -0.037 -0.037 -0.036 -0.036 -0.033 -0.027 -0.025 -0.024  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934  
 STRESS 139.300 -1.110 -1.104 -1.099 -1.093 -1.078 -1.069 -0.809 -0.749 -0.700

TIME= 6.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.00 152.60 152.57 152.55 152.52 152.44 151.93 151.12 150.82 150.58  
 MECH. STRAIN -0.020 -0.037 -0.037 -0.037 -0.036 -0.036 -0.033 -0.027 -0.025 -0.024  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934  
 STRESS 139.293 -1.110 -1.104 -1.099 -1.093 -1.078 -1.069 -0.809 -0.749 -0.700

TIME= 7.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 151.09 152.62 152.57 152.55 152.52 152.44 151.93 151.12 150.82 150.58  
 MECH. STRAIN -0.027 -0.037 -0.037 -0.037 -0.036 -0.036 -0.033 -0.027 -0.025 -0.024  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934 0.934  
 STRESS 139.264 -1.114 -1.104 -1.099 -1.093 -1.078 -1.069 -0.809 -0.749 -0.700





TIME=	8.00	INVOLVE MULTI-PASS EFFECT 3 PASS											
TEMPERATURE	109.16	152.86	152.59	152.55	152.52	152.44	152.40	151.93	151.12	150.82	150.58		
MECH. STRAIN	-0.150	-0.033	-0.036	-0.036	-0.036	-0.035	-0.035	-0.032	-0.026	-0.024	-0.023		
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	0.935	0.933	0.935	0.935	0.935	0.935	0.935	0.935	0.935	0.935	0.935		
STRESS	135.142	-1.136	-1.061	-1.073	-1.067	-1.051	-1.043	-0.949	-0.703	-0.722	-0.674		
TIME=	10.00	INVOLVE MULTI-PASS EFFECT 3 PASS											
TEMPERATURE	475.62	155.76	152.60	152.56	152.54	152.44	152.40	151.93	151.12	150.82	150.58		
MECH. STRAIN	-2.923	-0.042	-0.021	-0.020	-0.020	-0.019	-0.019	-0.016	-0.010	-0.008	-0.007		
PLASTIC STRAIN	-4.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	0.951	0.951	0.951	0.951	0.951	0.951	0.951	0.951	0.951	0.951	0.951		
STRESS	64.705	-1.247	-0.623	-0.599	-0.590	-0.574	-0.565	-0.471	-0.305	-0.245	-0.196		
TIME=	10.00	INVOLVE MULTI-PASS EFFECT 3 PASS											
TEMPERATURE	4500.00	167.40	153.42	152.63	152.53	152.44	152.40	151.93	151.12	150.82	150.58		
MECH. STRAIN	-17.581	-0.032	0.067	0.072	0.073	0.074	0.074	0.077	0.083	0.085	0.086		
PLASTIC STRAIN	-17.581	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	1.044	1.044	1.044	1.044	1.044	1.044	1.044	1.044	1.044	1.044	1.044		
STRESS	0.0	-0.941	1.990	2.151	2.171	2.169	2.198	2.292	2.453	2.519	2.567		
TIME=	11.00	INVOLVE MULTI-PASS EFFECT 3 PASS											
TEMPERATURE	2500.00	197.59	155.36	152.84	152.56	152.44	152.40	151.93	151.12	150.82	150.58		
MECH. STRAIN	-17.571	-0.229	0.064	0.081	0.083	0.084	0.084	0.087	0.093	0.095	0.097		
PLASTIC STRAIN	-17.571	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	1.054	1.054	1.054	1.054	1.054	1.054	1.054	1.054	1.054	1.054	1.054		
STRESS	0.0	-6.774	1.903	2.415	2.471	2.496	2.505	2.599	2.765	2.826	2.874		
TIME=	12.00	INVOLVE MULTI-PASS EFFECT 3 PASS											
TEMPERATURE	2500.00	219.89	154.77	153.85	152.66	152.45	152.40	151.93	151.12	150.82	150.58		
MECH. STRAIN	-17.555	-0.515	0.051	0.090	0.098	0.099	0.100	0.103	0.108	0.110	0.112		
PLASTIC STRAIN	-17.555	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070	1.070		
STRESS	0.0	-15.166	1.503	2.606	2.998	2.951	2.961	3.056	3.222	3.283	3.331		
TIME=	13.00	INVOLVE MULTI-PASS EFFECT 3 PASS											
TEMPERATURE	4500.00	240.76	166.58	155.48	152.88	152.45	152.40	151.93	151.12	150.82	150.58		
MECH. STRAIN	-17.540	-0.797	0.018	0.094	0.112	0.115	0.115	0.119	0.124	0.126	0.128		
PLASTIC STRAIN	-17.540	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065		
STRESS	0.0	-23.354	0.541	2.806	3.334	3.421	3.431	3.527	3.692	3.753	3.802		
TIME=	14.00	INVOLVE MULTI-PASS EFFECT 3 PASS											
TEMPERATURE	4500.00	313.19	176.36	158.13	151.74	152.47	152.40	151.93	151.12	150.82	150.58		
MECH. STRAIN	-17.526	-1.023	-0.034	0.050	0.120	0.129	0.129	0.132	0.138	0.140	0.142		
PLASTIC STRAIN	-17.526	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099	1.099		
STRESS	0.0	-29.458	-0.955	2.680	3.573	3.831	3.845	3.941	4.107	4.168	4.216		



TIME= 15.00	INVOLVE MULTI-PASS EFFECT J PASS									
TEMPERATURE	2407.74	316.57	187.18	161.88	154.79	152.51	152.41	151.93	151.12	150.82
MECH. STRAIN	-16.749	-1.270	-0.182	-0.007	0.041	0.050	0.050	0.061	0.060	0.070
PLASTIC STRAIN	-17.526	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	-24.275	-1.028	-1.028	-1.028	-1.028	-1.028	-1.028	-1.028	-1.028	-1.028
STRESS	1.208	-0.937	-5.006	-0.213	1.231	1.694	1.713	1.810	1.976	2.037
TIME= 16.00	INVOLVE MULTI-PASS EFFECT J PASS									
TEMPERATURE	2500.00	352.74	198.97	166.60	156.30	152.57	152.43	151.93	151.12	150.82
MECH. STRAIN	-17.505	-1.300	-0.172	0.053	0.123	0.149	0.150	0.153	0.159	0.162
PLASTIC STRAIN	-17.505	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	-1.120	1.120	1.120	1.120	1.120	1.120	1.120	1.120	1.120	1.120
STRESS	0.0	-37.711	-5.090	1.568	3.673	4.430	4.400	4.560	4.720	4.836
TIME= 17.00	INVOLVE MULTI-PASS EFFECT J PASS									
TEMP DOES NOT CONVERGE J= 1 T9,T0,TN= 2402.41 2404.83 2500.00***** USED T9 *****										
TEMPERATURE	2442.41	363.62	210.35	172.07	158.24	152.64	152.45	151.93	151.12	150.82
MECH. STRAIN	-17.450	-1.860	-0.330	-0.062	0.033	0.071	0.072	0.076	0.082	0.085
PLASTIC STRAIN	-17.505	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.340	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043	1.043
STRESS	0.005	-42.214	-9.764	-1.047	0.964	2.109	2.156	2.261	2.427	2.488
TIME= 18.00	INVOLVE MULTI-PASS EFFECT J PASS									
TEMPERATURE	2451.48	370.63	221.10	176.01	160.75	152.45	152.50	151.93	151.12	150.82
MECH. STRAIN	-17.204	-1.508	-0.401	-0.098	0.022	0.075	0.078	0.082	0.087	0.091
PLASTIC STRAIN	-17.505	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.049	1.049	1.049	1.049	1.049	1.049	1.049	1.049	1.049	1.049
STRESS	0.050	-43.616	-11.641	-2.897	0.644	2.245	2.318	2.432	2.594	2.707
TIME= 19.00	INVOLVE MULTI-PASS EFFECT J PASS									
TEMPERATURE	1596.09	375.02	236.06	186.17	163.50	153.44	152.56	151.93	151.12	150.82
MECH. STRAIN	-10.571	-1.538	-0.468	-0.138	0.005	0.074	0.080	0.085	0.093	0.094
PLASTIC STRAIN	-12.916	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051	1.051
STRESS	10.116	-44.461	-13.805	-4.082	0.141	2.208	2.387	2.515	2.681	2.792
TIME= 20.00	INVOLVE MULTI-PASS EFFECT J PASS									
TEMPERATURE	1536.93	377.41	239.40	190.33	166.76	153.92	152.66	151.93	151.12	150.82
MECH. STRAIN	-10.582	-1.552	-0.526	-0.177	-0.013	0.075	0.083	0.088	0.094	0.099
PLASTIC STRAIN	-12.910	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.055	1.055	1.055	1.055	1.055	1.055	1.055	1.055	1.055	1.055
STRESS	11.940	-44.860	-15.406	-5.242	-0.393	2.225	2.480	2.620	2.794	2.855
TIME= 30.00	INVOLVE MULTI-PASS EFFECT J PASS									
TEMPERATURE	1052.17	362.66	206.77	234.81	202.31	164.60	157.69	151.93	151.12	150.82
MECH. STRAIN	-7.408	-1.431	-0.938	-0.443	-0.238	0.010	0.057	0.098	0.113	0.117
PLASTIC STRAIN	-11.253	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065	1.065
STRESS	74.455	-41.444	-23.966	-14.245	-7.633	0.310	1.695	2.467	3.071	3.183



TIME= 40.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 855.26 337.86 285.31 250.94 220.66 179.64 167.53 151.95 151.12 150.82 150.58  
MECH. STRAIN -5.199 -1.239 -0.847 -0.596 -0.373 -0.305 0.0 0.0 0.0 0.0 0.111  
PLASTIC STRAIN -9.482 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.009 1.069 1.069 1.069 1.069 1.069 1.069 1.069 1.069 1.069 1.069  
STRESS 107.076 -36.028 -29.813 -17.527 -11.158 -2.515 -0.145 3.024 3.193 3.254 3.303

TIME= 50.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 648.38 316.77 280.20 258.36 224.83 190.29 176.95 152.04 151.12 150.82 150.58  
MECH. STRAIN -1.714 -1.079 -0.808 -0.619 -0.441 -0.102 0.0 0.0 0.0 0.0 0.112  
PLASTIC STRAIN -8.077 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.070 1.070 1.070 1.070 1.070 1.070 1.070 1.070 1.070 1.070 1.070  
STRESS 116.967 -31.878 -23.684 -18.206 -12.996 -4.793 -2.041 3.049 3.236 3.297 3.345

TIME= 60.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 542.59 290.53 272.58 252.62 232.56 197.65 184.29 152.29 151.12 150.82 150.58  
MECH. STRAIN -2.843 -0.952 -0.753 -0.607 -0.463 -0.214 -0.121 0.0 0.0 0.0 0.112  
PLASTIC STRAIN -7.301 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.069 1.069 1.069 1.069 1.069 1.069 1.069 1.069 1.069 1.069 1.069  
STRESS 125.044 -27.822 -22.089 -17.082 -11.839 -6.342 -3.576 2.975 3.212 3.273 3.322

TIME= 70.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 463.71 265.26 264.58 248.78 232.33 201.90 189.41 153.38 151.12 150.82 150.58  
MECH. STRAIN -2.212 -0.848 -0.696 -0.581 -0.463 -0.247 -0.158 0.0 0.0 0.0 0.112  
PLASTIC STRAIN -6.734 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.067 1.067 1.067 1.067 1.067 1.067 1.067 1.067 1.067 1.067 1.067  
STRESS 126.867 -24.843 -20.448 -17.104 -11.850 -7.297 -4.609 2.759 3.157 3.218 3.267

TIME= 80.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 403.99 273.30 256.92 246.12 230.53 204.22 192.70 153.93 151.12 150.82 150.58  
MECH. STRAIN -1.746 -0.763 -0.643 -0.550 -0.453 -0.265 -0.184 0.0 0.0 0.0 0.107  
PLASTIC STRAIN -6.310 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.004 1.004 1.004 1.004 1.004 1.004 1.004 1.004 1.004 1.004 1.004  
STRESS 131.346 -22.382 -18.910 -16.208 -11.349 -7.648 -5.457 2.499 3.071 3.132 3.180

TIME= 90.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 350.08 263.06 249.78 239.24 227.85 205.03 194.63 154.94 151.12 150.82 150.58  
MECH. STRAIN -1.340 -0.691 -0.595 -0.519 -0.437 -0.274 -0.201 0.0 0.0 0.0 0.104  
PLASTIC STRAIN -5.971 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.001 1.001 1.001 1.001 1.001 1.001 1.001 1.001 1.001 1.001 1.001  
STRESS 132.796 -20.307 -17.496 -15.276 -12.863 -8.114 -5.953 2.197 2.973 3.035 3.083

TIME= 100.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 319.46 254.26 244.24 234.42 224.79 204.91 195.56 156.02 151.12 150.82 150.58  
MECH. STRAIN -1.112 -0.610 -0.551 -0.467 -0.418 -0.277 -0.211 0.0 0.0 0.0 0.100  
PLASTIC STRAIN -5.758 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.056 1.056 1.056 1.056 1.056 1.056 1.056 1.056 1.056 1.056 1.056  
STRESS 133.905 -18.534 -16.221 -14.366 -12.394 -8.192 -6.250 1.873 2.868 2.920 2.972





TIME= 150.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 216.47 222.96 217.92 213.71 208.92 198.30 192.83 160.72 151.23 150.82 150.56  
MECH. STRAIN -0.377 -0.423 -0.387 -0.358 -0.324 -0.249 -0.210 0.013 0.377 0.080 0.082  
PLASTIC STRAIN -1.029 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.039 1.039 1.039 1.039 1.039 1.039 1.039 1.039 1.039 1.039 1.039  
STRESS 137.425 -12.498 -11.445 -10.566 -9.567 -7.358 -6.224 0.374 2.303 2.387 2.436

TIME= 200.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 177.74 203.87 201.12 196.77 196.35 189.79 186.42 162.95 151.57 150.83 150.58  
MECH. STRAIN -0.122 -0.305 -0.285 -0.269 -0.250 -0.206 -0.182 -0.020 0.058 0.063 0.065  
PLASTIC STRAIN -4.799 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.023 1.023 1.023 1.023 1.023 1.023 1.023 1.023 1.023 1.023 1.023  
STRESS 130.007 -9.014 -8.841 -7.954 -7.390 -6.095 -5.400 -0.502 1.733 1.664 1.914

TIME= 250.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 162.00 191.14 189.47 186.02 186.33 182.38 180.20 163.29 152.22 150.87 150.58  
MECH. STRAIN -0.027 -0.229 -0.210 -0.208 -0.196 -0.168 -0.153 -0.046 0.039 0.049 0.049  
PLASTIC STRAIN -4.716 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.308 1.008 1.008 1.008 1.008 1.008 1.008 1.008 1.008 1.008 1.008  
STRESS 139.483 -6.799 -6.454 -6.157 -5.366 -4.994 -4.584 -1.079 1.173 1.440 1.566

TIME= 300.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 155.31 182.01 180.94 180.02 178.93 176.32 174.86 162.63 152.87 150.94 150.59  
MECH. STRAIN 0.006 -0.178 -0.171 -0.164 -0.157 -0.139 -0.129 -0.044 0.024 0.036 0.014  
PLASTIC STRAIN -4.716 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.996 0.996 0.996 0.996 0.996 0.996 0.996 0.996 0.996 0.996 0.996  
STRESS 140.473 -5.286 -5.066 -4.876 -4.653 -4.117 -3.816 -1.315 0.712 1.062 1.133

TIME= 350.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 152.39 175.38 174.66 174.04 173.29 171.50 170.49 161.54 152.96 151.03 150.61  
MECH. STRAIN 0.016 -0.143 -0.136 -0.133 -0.126 -0.116 -0.109 -0.047 0.012 0.025 0.028  
PLASTIC STRAIN -4.716 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.905 0.905 0.905 0.905 0.905 0.905 0.905 0.905 0.905 0.905 0.905  
STRESS 140.803 -4.230 -4.082 -3.954 -3.881 -3.435 -3.227 -1.399 0.345 0.737 0.823

TIME= 400.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 151.09 170.42 169.91 169.48 168.96 167.69 166.97 160.32 153.11 151.14 150.64  
MECH. STRAIN 0.016 -0.117 -0.113 -0.110 -0.107 -0.098 -0.093 -0.047 0.002 0.016 0.019  
PLASTIC STRAIN -4.716 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.977 0.977 0.977 0.977 0.977 0.977 0.977 0.977 0.977 0.977 0.977  
STRESS 140.832 -3.467 -3.363 -3.275 -3.168 -2.909 -2.761 -1.405 0.061 0.462 0.561

TIME= 450.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.50 168.84 168.28 167.97 167.59 164.68 164.14 159.13 153.13 151.22 150.68  
MECH. STRAIN 0.016 -0.093 -0.095 -0.093 -0.091 -0.034 -0.031 -0.046 -0.005 0.006 0.011  
PLASTIC STRAIN -4.716 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.970 0.970 0.970 0.970 0.970 0.970 0.970 0.970 0.970 0.970 0.970  
STRESS 140.748 -2.905 -2.832 -2.764 -2.691 -2.504 -2.336 -1.374 -0.154 0.332 0.344





TIME= 500.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.23 163.73 163.46 163.24 162.96 162.27 161.68 158.04 153.06 151.29 150.73  
 MECH. STRAIN 0.309 -0.084 -0.082 -0.080 -0.078 -0.074 -0.071 -0.045 -0.011 0.001 0.035  
 PLASTIC STRAIN -4.716 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.964 0.964 0.964 0.964 0.964 0.964 0.964 0.964 0.964 0.964 0.964  
 STRESS 180.610 -2.486 -2.433 -2.386 -2.329 -2.190 -2.113 -1.328 -0.316 0.041 0.150

TIME= 550.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.26 161.46 161.27 161.09 160.36 160.06 157.07 152.93 151.36 150.77  
 MECH. STRAIN 0.304 -0.073 -0.072 -0.070 -0.069 -0.063 -0.043 -0.015 -0.004 0.000 0.030  
 PLASTIC STRAIN -4.716 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.959 0.959 0.959 0.959 0.959 0.959 0.959 0.959 0.959 0.959 0.959  
 STRESS 180.479 -2.171 -2.131 -2.095 -2.052 -1.947 -1.805 -1.278 -0.437 -0.116 0.001

TIME= 600.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.13 159.69 159.54 159.40 159.24 158.94 158.00 150.24 152.78 151.37 150.61  
 MECH. STRAIN 0.030 -0.005 -0.004 -0.003 -0.002 -0.001 -0.001 -0.001 -0.001 -0.001 -0.001  
 PLASTIC STRAIN -4.716 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.955 0.955 0.955 0.955 0.955 0.955 0.955 0.955 0.955 0.955 0.955  
 STRESS 180.383 -1.932 -1.901 -1.874 -1.841 -1.759 -1.712 -1.211 -0.529 -0.243 -0.110

TIME= 650.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.07 158.29 158.17 158.06 157.93 157.62 157.43 155.53 152.61 151.37 150.85  
 MECH. STRAIN -0.062 -0.059 -0.058 -0.057 -0.056 -0.054 -0.053 -0.040 -0.020 -0.011 -0.004  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.952 0.952 0.952 0.952 0.952 0.952 0.952 0.952 0.952 0.952 0.952  
 STRESS 139.825 -1.741 -1.717 -1.695 -1.669 -1.604 -1.567 -1.180 -0.585 -0.336 -0.231

TIME= 700.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.03 157.18 157.08 157.00 156.89 156.64 156.49 154.92 152.44 151.35 150.87  
 MECH. STRAIN -0.305 -0.054 -0.053 -0.053 -0.052 -0.050 -0.049 -0.038 -0.022 -0.014 -0.011  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.949 0.949 0.949 0.949 0.949 0.949 0.949 0.949 0.949 0.949 0.949  
 STRESS 139.746 -1.601 -1.582 -1.564 -1.543 -1.491 -1.461 -1.143 -0.641 -0.410 -0.322

TIME= 750.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.02 156.29 156.21 156.14 156.06 155.85 155.72 154.42 152.28 151.32 150.89  
 MECH. STRAIN -0.007 -0.050 -0.050 -0.049 -0.049 -0.047 -0.046 -0.037 -0.023 -0.016 -0.013  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.946 0.946 0.946 0.946 0.946 0.946 0.946 0.946 0.946 0.946 0.946  
 STRESS 139.678 -1.493 -1.477 -1.463 -1.445 -1.402 -1.377 -1.112 -0.680 -0.445 -0.339

TIME= 800.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.01 155.59 155.52 155.46 155.39 155.21 155.13 154.94 152.13 151.29 150.93  
 MECH. STRAIN -0.003 -0.047 -0.047 -0.047 -0.046 -0.045 -0.044 -0.037 -0.024 -0.018 -0.015  
 PLASTIC STRAIN -4.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.944 0.944 0.944 0.944 0.944 0.944 0.944 0.944 0.944 0.944 0.944  
 STRESS 139.620 -1.410 -1.396 -1.384 -1.364 -1.333 -1.312 -1.086 -0.739 -0.518 -0.459



TIME= 850.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.00 155.02 154.96 154.91 154.85 154.69 154.60 153.64 152.00 151.25 150.90  
MECH. STRAIN -0.011 -0.045 -0.045 -0.044 -0.044 -0.043 -0.042 -0.036 -0.025 -0.019 -0.017  
PLASTIC STRAIN 0.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.689 0.943 0.943 0.943 0.943 0.943 0.943 0.943 0.943 0.943 0.943  
STRESS 139.571 -1.344 -1.333 -1.322 -1.310 -1.279 -1.260 -1.065 -0.732 -0.500 -0.504

TIME= 900.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.00 154.56 154.51 154.47 154.41 154.28 154.20 153.24 151.68 151.23 150.89  
MECH. STRAIN -0.014 -0.043 -0.043 -0.043 -0.042 -0.041 -0.041 -0.035 -0.025 -0.021 -0.018  
PLASTIC STRAIN 0.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.686 0.941 0.941 0.941 0.941 0.941 0.941 0.941 0.941 0.941 0.941  
STRESS 139.531 -1.290 -1.280 -1.271 -1.260 -1.232 -1.216 -1.043 -0.740 -0.528 -0.540

TIME= 950.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.00 154.19 154.15 154.11 154.06 153.94 153.87 153.13 151.77 151.26 150.88  
MECH. STRAIN -0.014 -0.042 -0.042 -0.041 -0.041 -0.040 -0.040 -0.035 -0.025 -0.022 -0.019  
PLASTIC STRAIN 0.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.686 0.940 0.940 0.940 0.940 0.940 0.940 0.940 0.940 0.940 0.940  
STRESS 139.498 -1.250 -1.241 -1.233 -1.223 -1.199 -1.184 -1.029 -0.759 -0.555 -0.573

TIME= 1000.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.00 153.90 153.86 153.82 153.76 153.67 153.60 152.90 151.67 151.22 150.87  
MECH. STRAIN -0.014 -0.041 -0.041 -0.040 -0.040 -0.039 -0.039 -0.034 -0.026 -0.023 -0.020  
PLASTIC STRAIN 0.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.686 0.939 0.939 0.939 0.939 0.939 0.939 0.939 0.939 0.939 0.939  
STRESS 139.469 -1.219 -1.211 -1.204 -1.195 -1.172 -1.159 -1.017 -0.769 -0.577 -0.605

TIME= 1000.00 INVOLVE MULTI-PASS EFFECT 3 PASS

TEMPERATURE 150.00 153.90 153.86 153.82 153.76 153.67 153.60 152.90 151.67 151.22 150.87  
MECH. STRAIN -0.014 -0.041 -0.041 -0.040 -0.040 -0.039 -0.039 -0.034 -0.026 -0.023 -0.020  
PLASTIC STRAIN 0.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.686 0.939 0.939 0.939 0.939 0.939 0.939 0.939 0.939 0.939 0.939  
STRESS 139.469 -1.219 -1.211 -1.204 -1.195 -1.172 -1.159 -1.017 -0.769 -0.577 -0.605

TIME= 0.0 INVOLVE MULTI-PASS EFFECT 4 PASS

TEMPERATURE 150.00 153.90 153.86 153.82 153.76 153.67 153.60 152.90 151.67 151.22 150.87  
MECH. STRAIN -0.024 -0.050 -0.050 -0.050 -0.050 -0.049 -0.048 -0.044 -0.035 -0.032 -0.030  
PLASTIC STRAIN 0.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.676 0.940 0.940 0.940 0.940 0.940 0.940 0.940 0.940 0.940 0.940  
STRESS 139.167 -1.502 -1.494 -1.486 -1.477 -1.455 -1.442 -1.300 -1.051 -0.868 -0.888

TIME= 1.00 INVOLVE MULTI-PASS EFFECT 4 PASS

TEMPERATURE 150.00 153.90 153.86 153.82 153.76 153.67 153.60 152.90 151.67 151.22 150.87  
MECH. STRAIN -0.024 -0.050 -0.050 -0.050 -0.050 -0.049 -0.048 -0.044 -0.035 -0.032 -0.030  
PLASTIC STRAIN 0.700 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.676 0.940 0.940 0.940 0.940 0.940 0.940 0.940 0.940 0.940 0.940  
STRESS 139.167 -1.502 -1.494 -1.486 -1.477 -1.455 -1.442 -1.300 -1.051 -0.868 -0.888



TIME=	2.00	INVOLVE MULTI-PASS EFFECT										4	PASS
TEMPERATURE	150.00	153.90	153.86	153.82	153.78	153.67	153.60	152.90	151.67	151.22	150.87		
MECH. STRAIN	-0.024	-0.050	-0.050	-0.050	-0.050	-0.049	-0.048	-0.044	-0.035	-0.032	-0.030		
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930		
STRESS	139.187	-1.502	-1.494	-1.486	-1.477	-1.455	-1.442	-1.300	-1.051	-0.960	-0.888		
TIME=	3.00	INVOLVE MULTI-PASS EFFECT										4	PASS
TEMPERATURE	150.00	153.90	153.86	153.82	153.78	153.67	153.60	152.90	151.67	151.22	150.87		
MECH. STRAIN	-0.024	-0.050	-0.050	-0.050	-0.050	-0.049	-0.048	-0.044	-0.035	-0.032	-0.030		
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930		
STRESS	139.187	-1.502	-1.494	-1.486	-1.477	-1.455	-1.442	-1.300	-1.051	-0.960	-0.888		
TIME=	4.00	INVOLVE MULTI-PASS EFFECT										4	PASS
TEMPERATURE	150.00	153.90	153.86	153.82	153.78	153.67	153.60	152.90	151.67	151.22	150.87		
MECH. STRAIN	-0.024	-0.050	-0.050	-0.050	-0.050	-0.049	-0.048	-0.044	-0.035	-0.032	-0.030		
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930		
STRESS	139.187	-1.502	-1.494	-1.486	-1.477	-1.455	-1.442	-1.300	-1.051	-0.960	-0.888		
TIME=	5.00	INVOLVE MULTI-PASS EFFECT										4	PASS
TEMPERATURE	150.00	153.90	153.86	153.82	153.78	153.67	153.60	152.90	151.67	151.22	150.87		
MECH. STRAIN	-0.024	-0.050	-0.050	-0.050	-0.050	-0.049	-0.048	-0.044	-0.035	-0.032	-0.030		
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930		
STRESS	139.187	-1.502	-1.494	-1.486	-1.477	-1.455	-1.442	-1.300	-1.051	-0.960	-0.888		
TIME=	6.00	INVOLVE MULTI-PASS EFFECT										4	PASS
TEMPERATURE	150.00	153.90	153.86	153.82	153.78	153.67	153.60	152.90	151.67	151.22	150.87		
MECH. STRAIN	-0.024	-0.050	-0.050	-0.050	-0.050	-0.049	-0.048	-0.044	-0.035	-0.032	-0.030		
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930		
STRESS	139.187	-1.502	-1.494	-1.486	-1.477	-1.455	-1.442	-1.300	-1.051	-0.960	-0.888		
TIME=	7.00	INVOLVE MULTI-PASS EFFECT										4	PASS
TEMPERATURE	150.00	153.90	153.86	153.82	153.78	153.67	153.60	152.90	151.67	151.22	150.87		
MECH. STRAIN	-0.024	-0.050	-0.050	-0.050	-0.050	-0.049	-0.048	-0.044	-0.035	-0.032	-0.030		
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930		
STRESS	139.187	-1.502	-1.494	-1.486	-1.477	-1.455	-1.442	-1.300	-1.051	-0.960	-0.888		
TIME=	8.00	INVOLVE MULTI-PASS EFFECT										4	PASS
TEMPERATURE	160.00	154.10	153.97	153.82	153.78	153.67	153.60	152.90	151.67	151.22	150.87		
MECH. STRAIN	-0.124	-0.051	-0.049	-0.049	-0.049	-0.048	-0.048	-0.044	-0.035	-0.032	-0.030		
PLASTIC STRAIN	-0.700	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
TOTAL STRAIN	0.931	0.931	0.931	0.931	0.931	0.931	0.931	0.931	0.931	0.931	0.931		
STRESS	139.026	-1.533	-1.473	-1.462	-1.453	-1.430	-1.417	-1.275	-1.027	-0.935	-0.863		





TIME= 9.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 409.05 157.06 153.97 153.78 153.67 153.60 152.90 151.67 151.22 150.87  
 MECH. STRAIN -1.903 -0.055 -0.033 -0.032 -0.031 -0.031 -0.026 -0.013 -0.015 -0.012  
 PLASTIC STRAIN -4.760 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.947 0.947 0.947 0.947 0.947 0.947 0.947 0.947 0.947 0.947  
 STRESS 80.444 -1.624 -0.996 -0.969 -0.957 -0.934 -0.774 -0.531 -0.439 -0.367

TIME= 10.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 2500.00 169.10 154.71 153.90 153.79 153.67 153.60 152.90 151.67 151.22 150.87  
 MECH. STRAIN -17.575 -0.035 0.064 0.069 0.070 0.071 0.071 0.076 0.084 0.090  
 PLASTIC STRAIN -17.575 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.350 1.050 1.050 1.050 1.050 1.050 1.050 1.050 1.050 1.050  
 STRESS 0.0 -1.041 1.696 2.060 2.083 2.108 2.122 2.264 2.513 2.604 2.677

TIME= 11.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 2500.00 194.89 156.65 154.12 153.82 153.67 153.60 152.90 151.67 151.22 150.87  
 MECH. STRAIN -17.565 -0.232 0.061 0.078 0.080 0.081 0.082 0.086 0.095 0.100  
 PLASTIC STRAIN -17.565 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.060 1.060 1.060 1.060 1.060 1.060 1.060 1.060 1.060 1.060  
 STRESS 0.0 -6.077 1.009 2.324 2.384 2.415 2.429 2.571 2.820 2.912 2.964

TIME= 12.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 2500.00 241.16 160.86 155.13 153.72 153.67 153.60 152.90 151.67 151.22 150.87  
 MECH. STRAIN -17.550 -0.518 0.047 0.087 0.095 0.097 0.097 0.102 0.110 0.116  
 PLASTIC STRAIN -17.550 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.375 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075 1.075  
 STRESS 0.0 -15.267 1.408 2.575 2.821 2.872 2.885 3.028 3.277 3.368 3.441

TIME= 13.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 2406.70 282.00 167.87 156.75 154.14 153.68 153.60 152.90 151.67 151.22 150.87  
 MECH. STRAIN -16.807 -0.881 -0.366 0.011 0.029 0.032 0.032 0.037 0.045 0.048 0.051  
 PLASTIC STRAIN -17.550 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.011 1.011 1.011 1.011 1.011 1.011 1.011 1.011 1.011 1.011 1.011  
 STRESS 0.277 -25.812 -1.947 0.319 0.650 0.945 0.960 1.102 1.351 1.443 1.515

TIME= 14.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 2500.00 314.41 177.37 159.41 155.00 153.69 153.60 152.90 151.67 151.22 150.87  
 MECH. STRAIN -17.520 -1.027 -0.337 0.087 0.117 0.126 0.127 0.132 0.140 0.143 0.145  
 PLASTIC STRAIN -17.520 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.105 1.105 1.105 1.105 1.105 1.105 1.105 1.105 1.105 1.105 1.105  
 STRESS 0.0 -29.953 -1.092 2.508 3.485 3.752 3.770 3.913 4.162 4.254 4.326

TIME= 15.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 2500.00 337.77 186.47 163.16 156.05 153.73 153.60 152.90 151.67 151.22 150.87  
 MECH. STRAIN -17.509 -1.191 -0.103 0.073 0.121 0.137 0.138 0.143 0.151 0.154 0.157  
 PLASTIC STRAIN -17.509 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.116 1.116 1.116 1.116 1.116 1.116 1.116 1.116 1.116 1.116 1.116  
 STRESS 0.0 -34.616 -3.043 2.103 3.613 4.005 4.109 4.253 4.502 4.594 4.667





TIME= 10.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 1547.60 353.98 200.16 167.80 157.56 153.80 153.63 152.90 151.67 151.22 150.87  
MECH. STRAIN -10.76 -1.91 -0.283 -0.038 0.032 0.058 0.059 0.064 0.073 0.076 0.079  
PLASTIC STRAIN -13.107 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.038 1.038 1.038 1.038 1.038 1.038 1.038 1.038 1.038 1.038 1.038  
STRESS 12.424 -40.358 -7.797 -1.143 0.904 1.729 1.763 1.911 2.160 2.251 2.324

TIME= 17.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 1470.73 364.81 211.63 173.35 159.55 153.91 153.65 152.90 151.67 151.22 150.87  
MECH. STRAIN -10.463 -1.468 -0.339 -0.071 0.024 0.063 0.065 0.070 0.076 0.080 0.084  
PLASTIC STRAIN -13.107 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.043 1.043 1.043 1.043 1.043 1.043 1.043 1.043 1.043 1.043 1.043  
STRESS 16.524 -42.515 -10.017 -2.095 0.726 1.675 1.926 2.079 2.328 2.419 2.492

TIME= 18.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 1402.07 371.87 222.37 179.29 162.01 154.08 153.70 152.90 151.67 151.22 150.87  
MECH. STRAIN -10.238 -1.518 -0.411 -0.108 0.012 0.066 0.069 0.074 0.082 0.085 0.088  
PLASTIC STRAIN -13.107 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.047 1.047 1.047 1.047 1.047 1.047 1.047 1.047 1.047 1.047 1.047  
STRESS 22.402 -43.904 -12.182 -3.195 0.346 1.561 2.039 2.200 2.449 2.541 2.613

TIME= 19.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 1340.00 376.21 232.13 185.44 164.06 154.67 153.76 152.90 151.67 151.22 150.87  
MECH. STRAIN -9.918 -1.548 -0.478 -0.148 -0.005 0.065 0.071 0.077 0.085 0.088 0.091  
PLASTIC STRAIN -13.107 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.050 1.050 1.050 1.050 1.050 1.050 1.050 1.050 1.050 1.050 1.050  
STRESS 30.077 -44.750 -14.106 -4.381 -0.153 1.924 2.107 2.283 2.532 2.623 2.696

TIME= 20.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 1282.53 378.60 240.65 191.60 168.02 155.14 153.80 152.90 151.67 151.22 150.87  
MECH. STRAIN -9.548 -1.564 -0.538 -0.189 -0.025 0.064 0.072 0.079 0.087 0.090 0.093  
PLASTIC STRAIN -12.937 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.052 1.052 1.052 1.052 1.052 1.052 1.052 1.052 1.052 1.052 1.052  
STRESS 37.807 -45.198 -15.836 -5.591 -0.737 1.891 2.150 2.346 2.595 2.686 2.759

TIME= 30.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 874.55 363.49 282.00 236.06 201.56 165.91 159.13 152.90 151.67 151.22 150.87  
MECH. STRAIN -5.746 -1.446 -0.833 -0.496 -0.253 0.004 0.043 0.085 0.093 0.096 0.099  
PLASTIC STRAIN -9.434 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.058 1.058 1.058 1.058 1.058 1.058 1.058 1.058 1.058 1.058 1.058  
STRESS 100.854 -41.882 -24.408 -14.609 -7.475 -0.123 1.268 2.528 2.777 2.869 2.942

TIME= 40.00 INVOLVE MULTI-PASS EFFECT # PASS

TEMPERATURE 609.28 339.09 286.55 252.19 221.90 180.26 160.70 152.91 151.67 151.22 150.87  
MECH. STRAIN -4.075 -1.253 -0.661 -0.609 -0.391 0.000 0.018 0.090 0.099 0.102 0.104  
PLASTIC STRAIN -8.393 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.064 1.064 1.064 1.064 1.064 1.064 1.064 1.064 1.064 1.064 1.064  
STRESS 116.104 -36.421 -25.211 -17.923 -11.553 -7.902 -0.527 2.692 2.944 3.035 3.108







TIME= 200.00	INVOLVE MULTI-PASS EFFECT 4 PASS											
TEMPERATURE	190.59	235.17	200.39	200.03	197.30	191.01	197.62	163.92	152.13	151.23	150.87	
MECH. STRAIN	-0.215	-0.316	-0.290	-0.282	-0.262	-0.218	-0.195	-0.030	0.050	0.356	0.059	
PLASTIC STRAIN	-4.884	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	1.019	1.019	1.019	1.019	1.019	1.019	1.019	1.019	1.019	1.019	1.019	
STRESS	138.341	-9.404	-8.027	-8.338	-7.771	-6.467	-5.768	-0.901	1.493	1.680	1.755	
TIME= 250.00	INVOLVE MULTI-PASS EFFECT 4 PASS											
TEMPERATURE	170.92	192.43	190.74	189.29	187.59	183.60	181.33	164.26	152.78	151.27	150.87	
MECH. STRAIN	-0.043	-0.243	-0.231	-0.221	-0.209	-0.181	-0.165	-0.047	0.032	0.042	0.085	
PLASTIC STRAIN	-8.775	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	1.004	1.004	1.004	1.004	1.004	1.004	1.004	1.004	1.004	1.004	1.004	
STRESS	139.054	-7.184	-6.035	-6.536	-6.185	-5.362	-4.907	-1.395	0.941	1.247	1.329	
TIME= 300.00	INVOLVE MULTI-PASS EFFECT 4 PASS											
TEMPERATURE	161.02	183.31	182.22	181.29	180.19	177.55	176.05	163.60	153.23	151.34	150.88	
MECH. STRAIN	-0.037	-0.191	-0.184	-0.177	-0.170	-0.151	-0.141	-0.055	0.016	0.029	0.032	
PLASTIC STRAIN	-8.727	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.92	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	0.992	
STRESS	139.419	-5.677	-3.454	-5.262	-5.036	-4.492	-4.186	-1.636	0.474	0.855	0.950	
TIME= 350.00	INVOLVE MULTI-PASS EFFECT 4 PASS											
TEMPERATURE	155.97	176.68	175.95	175.31	174.55	172.72	171.69	162.50	153.52	151.44	150.90	
MECH. STRAIN	-0.013	-0.156	-0.151	-0.146	-0.141	-0.126	-0.121	-0.058	0.003	0.018	0.021	
PLASTIC STRAIN	-8.706	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	0.981	
STRESS	139.608	-4.625	-4.475	-4.344	-4.188	-3.814	-3.602	-1.725	0.102	0.525	0.635	
TIME= 400.00	INVOLVE MULTI-PASS EFFECT 4 PASS											
TEMPERATURE	153.19	171.71	171.21	170.76	170.22	168.92	168.17	161.29	153.66	151.54	150.93	
MECH. STRAIN	-0.002	-0.130	-0.126	-0.123	-0.119	-0.110	-0.105	-0.058	-0.006	0.009	0.013	
PLASTIC STRAIN	-8.698	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.973	0.973	0.973	0.973	0.973	0.973	0.973	0.973	0.973	0.973	0.973	
STRESS	139.708	-3.866	-3.743	-3.651	-3.540	-3.274	-3.122	-1.717	-0.167	0.265	0.388	
TIME= 450.00	INVOLVE MULTI-PASS EFFECT 4 PASS											
TEMPERATURE	151.74	167.94	167.57	167.24	166.85	165.90	165.35	160.10	153.68	151.63	150.97	
MECH. STRAIN	0.000	-0.111	-0.108	-0.106	-0.103	-0.097	-0.093	-0.057	-0.013	0.001	0.006	
PLASTIC STRAIN	-8.693	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.966	0.966	0.966	0.966	0.966	0.966	0.966	0.966	0.966	0.966	0.966	
STRESS	139.811	-3.287	-3.211	-3.144	-3.065	-2.869	-2.757	-1.687	-0.363	0.033	0.167	
TIME= 500.00	INVOLVE MULTI-PASS EFFECT 4 PASS											
TEMPERATURE	150.96	166.03	164.75	164.51	164.22	163.50	163.08	159.01	153.62	151.70	151.01	
MECH. STRAIN	-0.000	-0.097	-0.095	-0.093	-0.091	-0.086	-0.083	-0.055	-0.016	-0.005	-0.001	
PLASTIC STRAIN	-8.697	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	
STRESS	139.792	-2.809	-2.812	-2.763	-2.703	-2.556	-2.472	-1.482	-0.547	-0.159	-0.019	











[illegible]



TIME= 3.00 INVOLVE MULTI-PASS EFFECT 5 PASS

150.01 155.20 155.14 155.09 155.04 154.89 154.80 153.87 152.23 151.63 151.15  
 TEMPERATURE -0.029 -0.068 -0.064 -0.064 -0.063 -0.062 -0.062 -0.055 -0.044 -0.040 -0.037  
 MECH. STRAIN -4.697 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 PLASTIC STRAIN 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925  
 TOTAL STRAIN 138.946 -1.918 -1.907 -1.897 -1.885 -1.855 -1.837 -1.848 -1.817 -1.795 -1.768  
 STRESS

TIME= 4.00 INVOLVE MULTI-PASS EFFECT 5 PASS

150.01 155.20 155.14 155.09 155.04 154.89 154.80 153.87 152.23 151.63 151.15  
 TEMPERATURE -0.029 -0.068 -0.064 -0.064 -0.063 -0.062 -0.062 -0.055 -0.044 -0.040 -0.037  
 MECH. STRAIN -4.697 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 PLASTIC STRAIN 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925  
 TOTAL STRAIN 138.946 -1.918 -1.907 -1.897 -1.885 -1.855 -1.837 -1.848 -1.817 -1.795 -1.768  
 STRESS

TIME= 5.00 INVOLVE MULTI-PASS EFFECT 5 PASS

150.01 155.20 155.14 155.09 155.04 154.89 154.80 153.87 152.23 151.63 151.15  
 TEMPERATURE -0.029 -0.068 -0.064 -0.064 -0.063 -0.062 -0.062 -0.055 -0.044 -0.040 -0.037  
 MECH. STRAIN -4.697 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 PLASTIC STRAIN 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925  
 TOTAL STRAIN 138.946 -1.918 -1.907 -1.897 -1.885 -1.855 -1.837 -1.848 -1.817 -1.795 -1.768  
 STRESS

TIME= 6.00 INVOLVE MULTI-PASS EFFECT 5 PASS

150.03 155.20 155.14 155.09 155.04 154.89 154.80 153.87 152.23 151.63 151.15  
 TEMPERATURE -0.029 -0.068 -0.064 -0.064 -0.063 -0.062 -0.062 -0.055 -0.044 -0.040 -0.037  
 MECH. STRAIN -4.697 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 PLASTIC STRAIN 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925  
 TOTAL STRAIN 138.946 -1.918 -1.907 -1.897 -1.885 -1.855 -1.837 -1.848 -1.817 -1.795 -1.768  
 STRESS

TIME= 7.00 INVOLVE MULTI-PASS EFFECT 5 PASS

150.40 155.22 155.15 155.10 155.04 154.89 154.80 153.87 152.23 151.63 151.15  
 TEMPERATURE -0.032 -0.065 -0.064 -0.064 -0.063 -0.062 -0.062 -0.055 -0.044 -0.040 -0.037  
 MECH. STRAIN -4.697 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 PLASTIC STRAIN 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925  
 TOTAL STRAIN 138.862 -1.922 -1.907 -1.897 -1.885 -1.855 -1.837 -1.848 -1.816 -1.794 -1.768  
 STRESS

TIME= 8.00 INVOLVE MULTI-PASS EFFECT 5 PASS

161.62 155.46 155.16 155.10 155.04 154.89 154.80 153.87 152.23 151.63 151.15  
 TEMPERATURE -0.108 -0.065 -0.063 -0.063 -0.063 -0.062 -0.061 -0.055 -0.043 -0.039 -0.036  
 MECH. STRAIN -4.697 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 PLASTIC STRAIN 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925 0.925  
 TOTAL STRAIN 138.841 -1.948 -1.888 -1.875 -1.862 -1.832 -1.814 -1.825 -1.794 -1.772 -1.745  
 STRESS

TIME= 9.00 INVOLVE MULTI-PASS EFFECT 5 PASS

367.96 158.37 155.26 155.11 155.04 154.89 154.80 153.87 152.23 151.63 151.15  
 TEMPERATURE -1.539 -0.068 -0.047 -0.046 -0.045 -0.044 -0.044 -0.037 -0.026 -0.022 -0.019  
 MECH. STRAIN 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 PLASTIC STRAIN 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 367.96 -2.027 -1.936 -1.866 -1.851 -1.821 -1.803 -1.814 -1.782 -1.760 -1.733  
 STRESS



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TIME=	17.00	INVOLVE MULTI-PASS EFFECT										5 PASS
TEMPERATURE	1256.76	166.00	212.91	174.63	160.82	155.13	154.85	153.87	152.23	151.63	151.15	
MECH. STRAIN	-9.375	-1.882	-0.353	-0.684	0.011	0.050	0.052	0.059	0.070	0.074	0.077	
PLASTIC STRAIN	-12.825	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	1.039	1.039	1.039	1.039	1.039	1.039	1.039	1.039	1.039	1.039	1.039	
STRESS	41.393	-42.507	-10.324	-2.459	0.326	1.485	1.540	1.741	2.073	2.195	2.292	
TIME=	18.00	INVOLVE MULTI-PASS EFFECT										5 PASS
TEMPERATURE	1184.50	373.06	223.65	186.57	163.27	155.30	154.90	153.07	152.23	151.63	151.15	
MECH. STRAIN	-8.746	-1.534	-0.428	-0.124	0.0	0.050	0.053	0.060	0.071	0.075	0.078	
PLASTIC STRAIN	-12.356	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	1.040	1.040	1.040	1.040	1.040	1.040	1.040	1.040	1.040	1.040	1.040	
STRESS	53.869	-44.374	-12.624	-3.680	-0.134	1.491	1.572	1.782	2.113	2.236	2.332	
TIME=	19.00	INVOLVE MULTI-PASS EFFECT										5 PASS
TEMPERATURE	1114.25	377.40	233.40	186.72	166.12	155.84	154.97	153.87	152.23	151.63	151.15	
MECH. STRAIN	-8.050	-1.567	-0.498	-0.167	-0.024	0.046	0.052	0.060	0.071	0.075	0.078	
PLASTIC STRAIN	-11.782	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	1.040	1.040	1.040	1.040	1.040	1.040	1.040	1.040	1.040	1.040	1.040	
STRESS	64.401	-45.308	-14.678	-4.952	-0.119	1.367	1.555	1.778	2.110	2.232	2.329	
TIME=	20.00	INVOLVE MULTI-PASS EFFECT										5 PASS
TEMPERATURE	1054.05	379.79	241.91	192.86	163.26	156.17	155.07	153.87	152.23	151.63	151.15	
MECH. STRAIN	-7.529	-1.585	-0.558	-0.209	-0.045	0.043	0.052	0.061	0.072	0.076	0.079	
PLASTIC STRAIN	-11.335	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041	1.041	
STRESS	78.241	-45.791	-16.447	-6.202	-1.184	1.293	1.557	1.801	2.133	2.255	2.352	
TIME=	30.00	INVOLVE MULTI-PASS EFFECT										5 PASS
TEMPERATURE	744.92	365.11	283.24	237.31	202.62	167.14	160.30	153.87	152.23	151.63	151.15	
MECH. STRAIN	-4.566	-1.461	-0.448	-0.514	-0.268	-0.014	0.028	0.072	0.083	0.088	0.091	
PLASTIC STRAIN	-8.823	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	1.052	1.052	1.052	1.052	1.052	1.052	1.052	1.052	1.052	1.052	1.052	
STRESS	112.163	-42.319	-24.450	-15.132	-7.916	-0.556	0.840	2.150	2.482	2.604	2.701	
TIME=	40.00	INVOLVE MULTI-PASS EFFECT										5 PASS
TEMPERATURE	603.94	346.33	287.79	253.43	223.15	181.49	160.90	153.88	152.23	151.63	151.15	
MECH. STRAIN	-3.354	-1.267	-0.875	-0.624	-0.405	-0.112	-0.031	0.073	0.090	0.094	0.097	
PLASTIC STRAIN	-7.755	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	1.059	
STRESS	121.777	-36.837	-25.629	-18.341	-11.469	-3.311	-0.931	2.339	2.674	2.796	2.893	
TIME=	50.00	INVOLVE MULTI-PASS EFFECT										5 PASS
TEMPERATURE	516.75	319.26	282.89	256.85	232.11	192.73	174.35	151.97	152.23	151.63	151.15	
MECH. STRAIN	-2.643	-1.108	-0.836	-0.647	-0.440	-0.183	-0.095	0.080	0.091	0.096	0.099	
PLASTIC STRAIN	-7.123	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL STRAIN	1.060	1.060	1.060	1.060	1.060	1.060	1.060	1.060	1.060	1.060	1.060	
STRESS	126.326	-32.293	-24.495	-19.015	-11.400	-5.563	-2.422	2.373	2.723	2.845	2.942	





TIME=	60.00	INVOLVE MULTI-PASS EFFECT 5 PASS									
TEMPERATURE	455.18	322.08	275.04	255.11	235.06	200.38	180.69	154.22	152.23	151.63	151.15
MECH. STRAIN	-2.152	-0.980	-0.701	-0.635	-0.499	-0.281	-0.187	0.077	0.091	0.095	0.098
PLASTIC STRAIN	-6.681	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.060	1.060	1.060	1.060	1.060	1.060	1.060	1.060	1.060	1.060	1.060
STRESS	129.185	-28.632	-22.893	-18.662	-14.434	-7.123	-4.349	2.304	2.708	2.836	2.927
TIME=	70.00	INVOLVE MULTI-PASS EFFECT 5 PASS									
TEMPERATURE	408.52	287.88	267.09	251.27	234.85	204.41	191.80	155.02	152.23	151.63	151.15
MECH. STRAIN	-1.788	-0.876	-0.724	-0.609	-0.490	-0.273	-0.184	0.070	0.089	0.093	0.097
PLASTIC STRAIN	-6.349	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.056	1.056	1.056	1.056	1.056	1.056	1.056	1.056	1.056	1.056	1.056
STRESS	131.161	-25.689	-21.249	-17.952	-14.442	-8.075	-5.457	2.091	2.677	2.779	2.876
TIME=	80.00	INVOLVE MULTI-PASS EFFECT 5 PASS									
TEMPERATURE	371.67	275.83	259.43	246.62	233.01	206.65	195.09	155.87	152.24	151.63	151.15
MECH. STRAIN	-1.508	-0.791	-0.671	-0.578	-0.479	-0.291	-0.210	0.062	0.086	0.091	0.094
PLASTIC STRAIN	-6.083	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.055	1.055	1.055	1.055	1.055	1.055	1.055	1.055	1.055	1.055	1.055
STRESS	122.306	-23.186	-19.709	-17.002	-14.137	-8.622	-6.222	1.835	2.574	2.676	2.793
TIME=	90.00	INVOLVE MULTI-PASS EFFECT 5 PASS									
TEMPERATURE	341.62	265.61	252.10	241.74	230.33	207.46	197.02	156.88	152.24	151.63	151.15
MECH. STRAIN	-1.289	-0.719	-0.622	-0.546	-0.464	-0.301	-0.227	0.052	0.080	0.087	0.091
PLASTIC STRAIN	-5.870	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.052	1.052	1.052	1.052	1.052	1.052	1.052	1.052	1.052	1.052	1.052
STRESS	133.266	-21.112	-18.298	-16.070	-13.671	-8.888	-6.718	1.533	2.476	2.599	2.696
TIME=	100.00	INVOLVE MULTI-PASS EFFECT 5 PASS									
TEMPERATURE	317.51	250.75	245.77	236.93	227.28	207.34	197.95	157.96	152.24	151.63	151.15
MECH. STRAIN	-1.106	-0.658	-0.578	-0.514	-0.445	-0.303	-0.237	0.041	0.080	0.084	0.087
PLASTIC STRAIN	-5.703	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.049	1.049	1.049	1.049	1.049	1.049	1.049	1.049	1.049	1.049	1.049
STRESS	138.026	-19.340	-17.022	-15.161	-13.134	-8.966	-7.015	1.268	2.371	2.494	2.591
TIME=	150.00	INVOLVE MULTI-PASS EFFECT 5 PASS									
TEMPERATURE	238.04	225.53	220.47	216.24	211.42	200.73	195.22	162.65	152.35	151.63	151.15
MECH. STRAIN	-0.541	-0.451	-0.415	-0.385	-0.351	-0.275	-0.236	-0.010	0.060	0.065	0.069
PLASTIC STRAIN	-5.179	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030	1.030
STRESS	136.671	-13.310	-12.251	-11.367	-10.362	-8.137	-6.994	-0.297	1.800	1.946	2.043
TIME=	200.00	INVOLVE MULTI-PASS EFFECT 5 PASS									
TEMPERATURE	199.00	206.46	203.67	201.30	198.56	192.33	188.82	164.89	152.69	151.64	151.15
MECH. STRAIN	-0.282	-0.332	-0.313	-0.296	-0.277	-0.232	-0.208	-0.042	0.041	0.040	0.040
PLASTIC STRAIN	-4.945	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	1.013	1.013	1.013	1.013	1.013	1.013	1.013	1.013	1.013	1.013	1.013
STRESS	130.020	-9.831	-9.253	-8.760	-8.190	-6.879	-6.174	-1.259	1.225	1.437	1.536



TIME= 250.00 INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 178.53 193.72 192.03 190.57 184.45 184.82 102.54 165.23 153.34 151.60 151.16  
MECH. STRAIN -0.151 -0.257 -0.245 -0.235 -0.223 -0.195 -0.119 -0.359 0.322 0.334 0.037  
PLASTIC STRAIN -0.828 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.999 0.999 0.999 0.999 0.999 0.999 0.999 0.999 0.999 0.999 0.999  
STRESS 138.776 -7.614 -7.263 -6.960 -6.605 -5.774 -5.315 -1.754 0.660 1.003 1.109

TIME= 300.00 INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 186.85 184.60 183.51 182.56 181.45 178.77 177.26 164.57 153.79 151.75 151.16  
MECH. STRAIN -0.083 -0.206 -0.198 -0.191 -0.184 -0.165 -0.155 -0.367 0.307 0.321 0.025  
PLASTIC STRAIN -4.768 0.3 0.0 0.0 0.3 0.0 0.0 0.0 0.3 0.3 0.0  
TOTAL STRAIN 0.986 0.986 0.986 0.986 0.986 0.986 0.986 0.986 0.986 0.986 0.986  
STRESS 134.203 -6.097 -5.873 -5.676 -5.447 -4.896 -4.586 -1.387 0.207 0.619 0.734

TIME= 350.00 INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 180.11 177.98 177.24 176.58 175.41 173.95 172.90 163.47 154.38 151.85 151.18  
MECH. STRAIN -0.047 -0.170 -0.165 -0.161 -0.155 -0.142 -0.135 -0.370 -0.306 0.310 0.014  
PLASTIC STRAIN -4.737 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.776 0.976 0.976 0.976 0.976 0.976 0.976 0.976 0.976 0.976 0.976  
STRESS 139.452 -5.051 -4.899 -4.764 -4.605 -4.224 -4.008 -2.002 -0.170 0.283 0.417

TIME= 400.00 INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 156.13 173.02 172.49 172.03 171.40 170.14 169.37 162.26 154.22 151.94 151.22  
MECH. STRAIN -0.028 -0.144 -0.141 -0.137 -0.134 -0.124 -0.119 -0.370 -0.315 0.300 0.005  
PLASTIC STRAIN -4.721 0.0 0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.967 0.967 0.967 0.967 0.967 0.967 0.967 0.967 0.967 0.967 0.967  
STRESS 135.559 -4.283 -4.176 -4.082 -3.968 -3.694 -3.538 -2.085 -0.451 0.311 0.159

TIME= 450.00 INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 153.75 169.24 168.86 168.52 168.11 167.12 166.55 161.07 154.24 152.04 151.26  
MECH. STRAIN -0.019 -0.125 -0.123 -0.120 -0.117 -0.111 -0.107 -0.369 -0.322 -0.307 -0.002  
PLASTIC STRAIN -4.714 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.960 0.960 0.960 0.960 0.960 0.960 0.960 0.960 0.960 0.960 0.960  
STRESS 139.688 -3.718 -3.640 -3.570 -3.488 -3.285 -3.168 -2.050 -0.663 -0.215 -0.057

TIME= 500.00 INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 152.31 166.33 166.04 165.79 165.48 164.72 164.28 159.98 154.17 152.11 151.30  
MECH. STRAIN -0.015 -0.111 -0.109 -0.107 -0.105 -0.100 -0.097 -0.367 -0.328 -0.314 -0.008  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954 0.954  
STRESS 139.741 -3.301 -3.242 -3.190 -3.127 -2.972 -2.883 -2.006 -0.827 -0.408 -0.244

TIME= 550.00 INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 151.43 164.07 163.84 163.64 163.40 162.81 162.47 159.01 154.05 152.17 151.35  
MECH. STRAIN -0.014 -0.100 -0.099 -0.098 -0.096 -0.092 -0.089 -0.366 -0.332 -0.319 -0.013  
PLASTIC STRAIN -4.711 0.0 0.3 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.949 0.949 0.949 0.949 0.949 0.949 0.949 0.949 0.949 0.949 0.949  
STRESS 139.774 -2.966 -2.941 -2.903 -2.851 -2.730 -2.660 -1.956 -0.949 -0.508 -0.401



TIME= 600.00  
INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 150.89 162.29 162.11 161.95 161.76 161.29 161.01 158.18 153.90 152.19 151.39  
MECH. STRAIN -0.015 -0.092 -0.091 -0.090 -0.089 -0.086 -0.084 -0.064 -0.035 -0.023 -0.018  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.945 0.945 0.945 0.945 0.945 0.945 0.945 0.945 0.945 0.945 0.945  
STRESS 139.767 -2.748 -2.712 -2.679 -2.640 -2.543 -2.447 -1.510 -1.041 -0.494 -0.533

TIME= 650.00  
INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 150.56 160.89 160.74 160.61 160.46 160.36 159.84 157.46 153.73 152.14 151.42  
MECH. STRAIN -0.016 -0.086 -0.085 -0.084 -0.083 -0.081 -0.079 -0.063 -0.037 0.0 0.0  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.942 0.942 0.942 0.942 0.942 0.942 0.942 0.942 0.942 0.942 0.942  
STRESS 139.736 -2.566 -2.535 -2.509 -2.477 -2.397 -2.351 -1.868 -1.110 -0.796 -0.643

TIME= 700.00  
INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 150.36 159.78 159.66 159.55 159.42 159.36 158.84 156.86 153.56 152.16 151.45  
MECH. STRAIN -0.017 -0.081 -0.080 -0.079 -0.078 -0.076 -0.075 -0.061 -0.039 -0.029 -0.024  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.939 0.939 0.939 0.939 0.939 0.939 0.939 0.939 0.939 0.939 0.939  
STRESS 139.710 -2.410 -2.385 -2.363 -2.336 -2.269 -2.229 -1.817 -1.147 -0.864 -0.719

TIME= 750.00  
INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 150.45 158.90 158.79 158.69 158.58 158.29 158.13 156.35 153.40 152.14 151.46  
MECH. STRAIN -0.020 -0.077 -0.077 -0.076 -0.075 -0.073 -0.072 -0.069 -0.040 0.0 0.0  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.937 0.937 0.937 0.937 0.937 0.937 0.937 0.937 0.937 0.937 0.937  
STRESS 139.618 -2.302 -2.281 -2.261 -2.238 -2.180 -2.146 -1.785 -1.186 -0.930 -0.794

TIME= 800.00  
INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 150.30 158.19 158.10 158.01 157.91 157.66 157.51 155.93 153.25 152.10 151.47  
MECH. STRAIN -0.021 -0.075 -0.074 -0.073 -0.073 -0.071 -0.070 -0.059 -0.041 -0.033 -0.023  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.935 0.935 0.935 0.935 0.935 0.935 0.935 0.935 0.935 0.935 0.935  
STRESS 139.590 -2.218 -2.200 -2.182 -2.162 -2.110 -2.080 -1.759 -1.216 -0.983 -0.856

TIME= 850.00  
INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 150.20 157.62 157.54 157.46 157.37 157.14 157.01 155.57 153.12 152.06 151.47  
MECH. STRAIN -0.022 -0.072 -0.072 -0.071 -0.071 -0.069 -0.068 -0.058 -0.042 -0.034 -0.030  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.933 0.933 0.933 0.933 0.933 0.933 0.933 0.933 0.933 0.933 0.933  
STRESS 139.561 -2.153 -2.136 -2.121 -2.102 -2.050 -2.029 -1.738 -1.239 -1.026 -0.900

TIME= 900.00  
INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 150.14 157.16 157.09 157.02 156.93 156.72 156.60 155.28 152.79 152.11 151.47  
MECH. STRAIN -0.023 -0.071 -0.070 -0.070 -0.069 -0.068 -0.067 -0.058 -0.042 -0.036 -0.032  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.932 0.932 0.932 0.932 0.932 0.932 0.932 0.932 0.932 0.932 0.932  
STRESS 139.530 -2.099 -2.084 -2.069 -2.052 -2.010 -1.995 -1.717 -1.253 -1.044 -0.943





TIME= 950.00 INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 156.10 156.80 156.73 156.66 156.58 156.39 156.27 155.04 152.89 152.07 151.46  
 MECH. STRAIN -0.024 -0.069 -0.069 -0.068 -0.068 -0.066 -0.066 -0.057 -0.043 -0.037 -0.033  
 PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.931 0.931 0.931 0.931 0.931 0.931 0.931 0.931 0.931 0.931 0.931  
 STRESS 139.511 -2.059 -2.045 -2.031 -2.016 -1.970 -1.953 -1.702 -1.266 -1.101 -0.976

TIME= 1000.00 INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 150.07 156.50 156.43 156.37 156.30 156.11 156.00 154.84 152.79 152.04 151.44  
 MECH. STRAIN -0.024 -0.068 -0.068 -0.067 -0.067 -0.066 -0.065 -0.057 -0.043 -0.038 -0.034  
 PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.930 0.930 0.930 0.930 0.930 0.930 0.930 0.930 0.930 0.930 0.930  
 STRESS 139.486 -2.028 -2.014 -2.002 -1.987 -1.949 -1.927 -1.690 -1.276 -1.123 -1.002

TIME= 1000.00 INVOLVE MULTI-PASS EFFECT 5 PASS

TEMPERATURE 150.07 156.50 156.43 156.37 156.30 156.11 156.00 154.84 152.79 152.04 151.44  
 MECH. STRAIN -0.024 -0.068 -0.068 -0.067 -0.067 -0.066 -0.065 -0.057 -0.043 -0.038 -0.034  
 PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.930 0.930 0.930 0.930 0.930 0.930 0.930 0.930 0.930 0.930 0.930  
 STRESS 139.486 -2.028 -2.014 -2.002 -1.987 -1.949 -1.927 -1.690 -1.276 -1.123 -1.002

TIME= 0.0 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 150.07 156.50 156.43 156.37 156.30 156.11 156.00 154.84 152.79 152.04 151.44  
 MECH. STRAIN -0.024 -0.078 -0.077 -0.077 -0.077 -0.075 -0.075 -0.067 -0.053 -0.048 -0.043  
 PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920  
 STRESS 139.197 -2.319 -2.305 -2.293 -2.277 -2.240 -2.218 -1.981 -1.567 -1.414 -1.293

TIME= 1.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 150.07 156.50 156.43 156.37 156.30 156.11 156.00 154.84 152.79 152.04 151.44  
 MECH. STRAIN -0.024 -0.078 -0.077 -0.077 -0.077 -0.075 -0.075 -0.067 -0.053 -0.048 -0.043  
 PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920  
 STRESS 139.197 -2.319 -2.305 -2.293 -2.277 -2.240 -2.218 -1.981 -1.567 -1.414 -1.293

TIME= 2.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 150.07 156.50 156.43 156.37 156.30 156.11 156.00 154.84 152.79 152.04 151.44  
 MECH. STRAIN -0.024 -0.078 -0.077 -0.077 -0.077 -0.075 -0.075 -0.067 -0.053 -0.048 -0.043  
 PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920  
 STRESS 139.197 -2.319 -2.305 -2.293 -2.277 -2.240 -2.218 -1.981 -1.567 -1.414 -1.293

TIME= 3.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 150.07 156.50 156.43 156.37 156.30 156.11 156.00 154.84 152.79 152.04 151.44  
 MECH. STRAIN -0.024 -0.078 -0.077 -0.077 -0.077 -0.075 -0.075 -0.067 -0.053 -0.048 -0.043  
 PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920  
 STRESS 139.197 -2.319 -2.305 -2.293 -2.277 -2.240 -2.218 -1.981 -1.567 -1.414 -1.293





TIME= 4.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 150.07 156.50 156.43 156.37 156.30 156.11 156.00 154.84 152.79 152.74 151.44  
MECH. STRAIN -0.034 -0.078 -0.077 -0.077 -0.077 -0.075 -0.075 -0.067 -0.055 -0.044 -0.034  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920  
STRESS 139.197 -2.319 -2.305 -2.293 -2.277 -2.240 -2.218 -1.901 -1.567 -1.414 -1.251

TIME= 5.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 150.07 156.50 156.43 156.37 156.30 156.11 156.00 154.84 152.79 152.74 151.44  
MECH. STRAIN -0.034 -0.078 -0.077 -0.077 -0.077 -0.075 -0.075 -0.067 -0.055 -0.044 -0.034  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920  
STRESS 139.197 -2.319 -2.305 -2.293 -2.277 -2.240 -2.218 -1.901 -1.567 -1.414 -1.251

TIME= 6.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 150.09 156.50 156.43 156.37 156.30 156.11 156.00 154.84 152.79 152.74 151.44  
MECH. STRAIN -0.034 -0.078 -0.077 -0.077 -0.077 -0.075 -0.075 -0.067 -0.055 -0.044 -0.034  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920  
STRESS 139.193 -2.319 -2.305 -2.292 -2.277 -2.240 -2.218 -1.981 -1.567 -1.414 -1.251

TIME= 7.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 150.19 156.52 156.43 156.37 156.30 156.11 156.00 154.84 152.79 152.74 151.44  
MECH. STRAIN -0.036 -0.078 -0.077 -0.077 -0.077 -0.075 -0.075 -0.067 -0.055 -0.044 -0.034  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920 0.920  
STRESS 139.126 -2.323 -2.305 -2.292 -2.277 -2.240 -2.217 -1.981 -1.566 -1.414 -1.251

TIME= 8.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 159.77 156.76 156.45 156.37 156.30 156.11 156.00 154.84 152.79 152.74 151.44  
MECH. STRAIN -0.100 -0.079 -0.077 -0.077 -0.076 -0.075 -0.074 -0.066 -0.052 -0.047 -0.043  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.921 0.921 0.921 0.921 0.921 0.921 0.921 0.921 0.921 0.921 0.921  
STRESS 137.099 -2.357 -2.294 -2.278 -2.263 -2.225 -2.203 -1.966 -1.552 -1.439 -1.274

TIME= 9.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 331.62 159.67 156.55 156.39 156.30 156.11 156.00 154.84 152.79 152.74 151.44  
MECH. STRAIN -1.323 -0.082 -0.060 -0.059 -0.059 -0.057 -0.057 -0.049 -0.035 -0.030 -0.026  
PLASTIC STRAIN -4.711 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 0.938 0.938 0.938 0.938 0.938 0.938 0.938 0.938 0.938 0.938 0.938  
STRESS 98.596 -2.429 -1.794 -1.762 -1.744 -1.706 -1.684 -1.447 -1.032 -0.880 -0.754

TIME= 10.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 2506.00 171.72 157.29 156.45 156.31 156.11 156.00 154.84 152.79 152.74 151.44  
MECH. STRAIN -17.564 -0.042 -0.057 -0.063 -0.064 -0.065 -0.066 -0.074 -0.084 -0.093 -0.097  
PLASTIC STRAIN -17.564 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.061 1.061 1.061 1.061 1.061 1.061 1.061 1.061 1.061 1.061 1.061  
STRESS 0.0 -1.240 1.708 1.878 1.907 1.947 1.970 2.207 2.022 2.119 2.036



TIME= 11.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 2500.00 201.49 159.23 150.67 156.14 156.11 156.00 154.84 152.79 152.04 151.44  
MECH. STRAIN -17.554 -0.239 0.054 0.072 0.074 0.076 0.077 0.085 0.098 0.104 0.108  
PLASTIC STRAIN -17.554 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.071 1.071 1.071 1.071 1.071 1.071 1.071 1.071 1.071 1.071 1.071  
STRESS 0.0 -7.042 1.620 2.142 2.268 2.255 2.277 2.515 2.930 3.083 3.204

TIME= 12.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 2500.00 243.70 163.44 157.68 156.14 156.12 156.00 154.84 152.79 152.04 151.44  
MECH. STRAIN -17.536 -0.525 0.041 0.080 0.091 0.092 0.100 0.100 0.114 0.119 0.123  
PLASTIC STRAIN -17.536 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.067 1.067 1.067 1.067 1.067 1.067 1.067 1.067 1.067 1.067 1.067  
STRESS 0.0 -15.470 1.218 2.392 2.645 2.711 2.734 2.972 3.387 3.540 3.661

TIME= 13.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 1498.15 284.48 170.45 159.31 156.60 156.12 156.00 154.84 152.79 152.04 151.44  
MECH. STRAIN -10.574 -0.895 -0.080 -0.003 0.015 0.019 0.020 0.028 0.042 0.047 0.051  
PLASTIC STRAIN -1.246 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.018 1.018 1.014 1.014 1.014 1.014 1.014 1.014 1.014 1.014 1.014  
STRESS 15.566 -26.227 -2.362 -0.067 0.452 0.562 0.586 0.823 1.238 1.391 1.512

TIME= 14.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 1363.12 316.84 179.95 161.97 157.53 156.14 156.01 154.84 152.79 152.04 151.44  
MECH. STRAIN -10.076 -1.129 -0.138 -0.014 0.016 0.026 0.027 0.035 0.049 0.054 0.058  
PLASTIC STRAIN -13.424 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.021 1.021 1.021 1.021 1.021 1.021 1.021 1.021 1.021 1.021 1.021  
STRESS 27.864 -32.911 -4.103 -0.418 0.487 0.769 0.795 1.038 1.449 1.602 1.723

TIME= 15.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 1255.89 340.18 191.05 165.72 158.57 156.18 156.02 154.84 152.79 152.04 151.44  
MECH. STRAIN -9.101 -1.299 -0.211 -0.035 0.014 0.030 0.031 0.039 0.053 0.058 0.062  
PLASTIC STRAIN -14.034 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.026 1.026 1.026 1.026 1.026 1.026 1.026 1.026 1.026 1.026 1.026  
STRESS 41.521 -37.766 -6.263 -1.055 0.403 0.899 0.946 1.162 1.577 1.730 1.851

TIME= 16.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 1157.79 350.33 202.72 170.44 160.08 156.24 156.03 154.84 152.79 152.04 151.44  
MECH. STRAIN -6.513 -1.021 -0.293 -0.067 0.004 0.030 0.032 0.040 0.054 0.059 0.063  
PLASTIC STRAIN -12.171 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027  
STRESS 59.191 -41.190 -6.658 -1.995 0.121 0.903 0.946 1.188 1.604 1.756 1.877

TIME= 17.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 1074.29 307.19 214.10 175.91 162.06 156.35 156.06 154.84 152.79 152.04 151.44  
MECH. STRAIN -7.642 -1.503 -0.374 -0.105 -0.010 0.030 0.032 0.040 0.054 0.059 0.063  
PLASTIC STRAIN -11.477 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
TOTAL STRAIN 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027 1.027  
STRESS 75.524 -43.507 -11.043 -3.115 -0.285 0.882 0.942 1.190 1.605 1.750 1.874









TIME= 70.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 348.24 289.07 268.34 252.52 236.09 205.63 193.00 155.98 152.79 152.04 151.44  
 MECH. STRAIN -1.636 -0.890 -0.737 -0.622 -0.503 -0.206 0.0 0.059 0.081 0.066 0.090  
 PLASTIC STRAIN -0.177 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.054 1.054 1.054 1.054 1.054 1.054 1.054 1.054 1.054 1.054 1.054  
 STRESS 131.469 -26.050 -21.648 -18.294 -14.836 -8.461 -5.839 1.760 2.409 2.562 2.683

TIME= 80.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 353.60 277.10 260.69 247.87 234.25 207.86 196.29 156.84 152.79 152.04 151.44  
 MECH. STRAIN -1.376 -0.804 -0.684 -0.591 -0.493 -0.305 -0.223 0.051 0.078 0.083 0.087  
 PLASTIC STRAIN -5.957 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.051 1.051 1.051 1.051 1.051 1.051 1.051 1.051 1.051 1.051 1.051  
 STRESS 132.895 -23.566 -20.107 -17.397 -14.529 -9.007 -6.603 1.504 2.327 2.400 2.601

TIME= 90.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 328.45 266.88 254.57 243.00 231.56 206.68 196.21 157.05 152.79 152.04 151.44  
 MECH. STRAIN -1.189 -0.733 -0.636 -0.554 -0.477 -0.314 -0.240 0.040 0.075 0.080 0.084  
 PLASTIC STRAIN -5.781 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.048 1.048 1.048 1.048 1.048 1.048 1.048 1.048 1.048 1.048 1.048  
 STRESS 133.679 -21.513 -18.697 -16.467 -14.064 -9.274 -7.098 1.202 2.229 2.363 2.504

TIME= 100.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 307.42 258.02 247.03 236.19 228.52 208.55 199.15 158.93 152.80 152.04 151.44  
 MECH. STRAIN -1.036 -0.672 -0.592 -0.528 -0.459 -0.316 -0.250 0.029 0.071 0.077 0.081  
 PLASTIC STRAIN -5.637 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.044 1.044 1.044 1.044 1.044 1.044 1.044 1.044 1.044 1.044 1.044  
 STRESS 134.350 -19.743 -17.421 -15.558 -13.527 -9.352 -7.396 0.877 2.124 2.278 2.394

TIME= 150.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 219.40 226.82 221.74 217.50 212.67 201.95 196.41 163.62 152.91 152.04 151.44  
 MECH. STRAIN -0.555 -0.465 -0.429 -0.398 -0.364 -0.288 -0.249 0.021 0.052 0.058 0.062  
 PLASTIC STRAIN -5.193 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.026 1.026 1.026 1.026 1.026 1.026 1.026 1.026 1.026 1.026 1.026  
 STRESS 130.623 -13.714 -12.652 -11.765 -10.756 -8.523 -7.375 -0.629 1.552 1.729 1.850

TIME= 200.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 203.87 207.75 204.95 202.57 199.81 193.44 190.02 165.86 153.24 152.05 151.44  
 MECH. STRAIN -0.319 -0.346 -0.326 -0.310 -0.290 -0.245 -0.221 -0.054 0.033 0.041 0.045  
 PLASTIC STRAIN -4.978 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 1.009 1.009 1.009 1.009 1.009 1.009 1.009 1.009 1.009 1.009 1.009  
 STRESS 137.805 -10.226 -9.654 -9.159 -8.588 -7.267 -6.558 -1.592 0.976 1.218 1.341

TIME= 250.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE 161.53 175.02 194.30 191.85 190.10 186.04 181.00 166.19 153.96 152.09 151.44  
 MECH. STRAIN -0.190 -0.211 -0.259 -0.248 -0.236 -0.208 -0.192 -0.070 0.018 0.026 0.031  
 PLASTIC STRAIN -4.808 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0  
 TOTAL STRAIN 0.994 0.994 0.994 0.994 0.994 0.994 0.994 0.994 0.994 0.994 0.994  
 STRESS 138.544 -8.014 -7.664 -7.362 -7.022 -6.163 -5.701 -2.004 0.415 0.782 0.911









TIME= 650.00	INVOLVE MULTI-PASS EFFECT 6 PASS									
TEMPERATURE	151.22	162.19	162.03	161.89	161.72	161.29	161.04	158.43	150.29	151.71
MECH. STRAIN	-0.725	-0.100	-0.099	-0.098	-0.097	-0.094	-0.092	-0.074	-0.046	-0.020
PLASTIC STRAIN	-0.722	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.937	0.937	0.937	0.937	0.937	0.937	0.937	0.937	0.937	0.937
STRESS	139.780	-2.974	-2.941	-2.912	-2.877	-2.769	-2.739	-2.208	-1.367	-0.688
TIME= 700.00	INVOLVE MULTI-PASS EFFECT 6 PASS									
TEMPERATURE	150.84	161.08	160.95	160.82	160.68	160.31	160.09	157.03	154.12	152.57
MECH. STRAIN	-0.025	-0.095	-0.094	-0.094	-0.093	-0.090	-0.089	-0.073	-0.048	-0.031
PLASTIC STRAIN	-0.722	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.934	0.934	0.934	0.934	0.934	0.934	0.934	0.934	0.934	0.934
STRESS	139.776	-2.834	-2.806	-2.781	-2.751	-2.676	-2.632	-2.172	-1.419	-0.936
TIME= 750.00	INVOLVE MULTI-PASS EFFECT 6 PASS									
TEMPERATURE	150.59	160.20	160.08	159.97	159.84	159.52	159.33	157.12	153.96	152.54
MECH. STRAIN	-0.026	-0.092	-0.091	-0.090	-0.089	-0.087	-0.086	-0.072	-0.049	-0.034
PLASTIC STRAIN	-0.722	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.932	0.932	0.932	0.932	0.932	0.932	0.932	0.932	0.932	0.932
STRESS	139.759	-2.726	-2.701	-2.679	-2.653	-2.587	-2.549	-2.160	-1.458	-0.911
TIME= 800.00	INVOLVE MULTI-PASS EFFECT 6 PASS									
TEMPERATURE	150.42	159.49	159.38	159.29	159.17	158.80	158.71	156.90	153.81	152.51
MECH. STRAIN	-0.027	-0.089	-0.088	-0.087	-0.087	-0.085	-0.083	-0.071	-0.050	-0.036
PLASTIC STRAIN	-0.722	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930	0.930
STRESS	139.736	-2.641	-2.619	-2.600	-2.576	-2.517	-2.483	-2.114	-1.488	-0.922
TIME= 850.00	INVOLVE MULTI-PASS EFFECT 6 PASS									
TEMPERATURE	150.53	158.92	158.83	158.74	158.63	158.37	158.21	156.54	153.67	152.47
MECH. STRAIN	-0.029	-0.047	-0.046	-0.045	-0.045	-0.043	-0.042	-0.070	-0.051	-0.038
PLASTIC STRAIN	-0.722	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.928	0.928	0.928	0.928	0.928	0.928	0.928	0.928	0.928	0.928
STRESS	139.683	-2.575	-2.555	-2.537	-2.516	-2.462	-2.430	-2.091	-1.509	-0.926
TIME= 900.00	INVOLVE MULTI-PASS EFFECT 6 PASS									
TEMPERATURE	150.39	158.47	158.39	158.29	158.20	157.95	157.80	156.25	153.55	152.52
MECH. STRAIN	-0.030	-0.085	-0.084	-0.084	-0.083	-0.081	-0.080	-0.070	-0.051	-0.039
PLASTIC STRAIN	-0.722	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.927	0.927	0.927	0.927	0.927	0.927	0.927	0.927	0.927	0.927
STRESS	139.653	-2.521	-2.502	-2.485	-2.465	-2.415	-2.386	-2.070	-1.523	-0.913
TIME= 950.00	INVOLVE MULTI-PASS EFFECT 6 PASS									
TEMPERATURE	150.30	158.10	158.01	157.94	157.84	157.61	157.47	156.01	153.44	152.48
MECH. STRAIN	-0.030	-0.083	-0.083	-0.082	-0.082	-0.080	-0.079	-0.069	-0.052	-0.040
PLASTIC STRAIN	-0.722	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.926	0.926	0.926	0.926	0.926	0.926	0.926	0.926	0.926	0.926
STRESS	139.639	-2.480	-2.463	-2.447	-2.428	-2.381	-2.354	-2.055	-1.536	-0.911



TIME= 1000.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE	150.23	157.80	157.72	157.65	157.56	157.34	157.21	155.80	153.35	152.45	151.73
MECH. STRAIN	-0.031	-0.082	-0.082	-0.081	-0.081	-0.079	-0.078	-0.063	-0.052	-0.046	-0.041
PLASTIC STRAIN	-4.722	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925
STRESS	139.625	-2.449	-2.432	-2.418	-2.400	-2.354	-2.328	-2.043	-1.546	-1.362	-1.217

TIME= 1000.00 INVOLVE MULTI-PASS EFFECT 6 PASS

TEMPERATURE	150.23	157.80	157.72	157.65	157.56	157.34	157.21	155.80	153.35	152.45	151.73
MECH. STRAIN	-0.031	-0.082	-0.082	-0.081	-0.081	-0.079	-0.078	-0.063	-0.052	-0.046	-0.041
PLASTIC STRAIN	-4.722	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL STRAIN	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925	0.925
STRESS	139.625	-2.449	-2.432	-2.418	-2.400	-2.354	-2.328	-2.043	-1.546	-1.362	-1.217





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